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An Analysis of the Relationship Between Certain Intellectual, Perceptual, Personality, and Achievement Factors and Scores on the Minnesota Percepto-Diagnostic Test

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AN ANALYSIS OF THE RELATIONSHIP BETWEEN CERTAIN INTELLECTUAL, PERCEPTUAL, PERSONALITY, AND ACHIEVEMENT FACTORS AND SCORES ON THE MINNESOTA PERCEPTO-DIAGNOSTIC TEST

by

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It is an obvious fact that dissertations are not the product of one man's work. It takes a lot of people - typists, clerks, computer experts, teachers, and administrators - to produce a piece of research. In humble recognition of this fact I desire to publicly acknowledge the help and cooperation extended me by the staffs of District 4 in Addison, Illinois and the Office of Research in Medical Education, University of Illinois. Special recognition is also due my advisor, Dr. Mayo, and the entire staff at the Loyola University Education Department, for their assistance.

And last but not least, I wish to commend my wife for her part in the dissertation. Without her help, there would have been no study.

ABOUT THE AUTHOR

The author has spent the largest part of his adult life as an educator in the Chicagoland Area. Starting out in the Chicago Public Schools soon after graduation, he taught for seven years at the junior high school level, first as a language arts teacher and then as a counselor.

In 1964, he became principal of the Old Mill School in Addison, Illinois, and shortly thereafter was given the concurrent post of Director of Research and Evaluation. After two years in Addison, the author was appointed to his present porition as Research Associate in the Office of Research in Medical Education at the University of Illinois Medical School.

Married and the father of five children, the author currently resides in Elmhurst, Illinois. Future plans call for him to continue his work in the field of educational psychology and to continue as a career reservist in the U.S. Army Reserve.

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STATEMENT OF THE PROBLEM

Picture yourself writing your name in a foreign language so different from English that it makes absolutely no sense to you. In this language there are no words and letters, no syllables or patterns of language. There are only a large number of peculiar markings that are often found together.

The only way to write your name is to memorize the way these peculiar markings look and to reproduce them a line at a time. You must remember the markings like this: Sideways line with up and down line under it; up and down line with half an up and down line next to it and both connected by a small sideways line; up and down line with three little lines sticking out of it.

This is how a brain damaged child might learn to write, "ThE".

The fact that there may be hundreds of thousands of children who approach learning in this manner is the first big reason for the current study. The second is the large number of children who have undetected personality problems of a serious nature.

To state our purpose as simply as possible, the problem with which we are concerned is this. In the U.S. today, hundreds of thousands of children are suffering from hidden brain damage. Other hundreds of thousands of children have undiagnosed personality disorders of a serious nature. No one knows for certain how many children fall into these categories due to the difficulty of diagnosing such cases and projecting from small samples.

Such research as has been conducted leads us to believe the number is extremely large. What we seek to do in this study is gain as much information as possible about a test called the Minnesota Percepto-Diagnostic Test (hereafter referred to as M.P.D.), a test which may have a great deal of potential in the diagnosis of brain damage and personality disorders. This test appears to have great promise, but thus far all we can say about it is that it appears to work. Why it works has only been theorized. If we could discover what factors influence a person's score on the M.P.D., this information would serve as the means for increased efficiency in the use of the test as well as the basis for later studies.

Specifically we shall attempt to achieve our general purpose by determining the relationship between a currently defined set of intellectual, perceptual, personality, and scholastic factors and success or failure on the M.P.D. test.

Now it must be made clear at this point that the major emphasis in this study will be the area of brain dysfunction. Some attention will be turned toward a discussion of personality disorders as the M.P.D. is intended as a diagnostic tool in this area also. But the author feels that each area is so important in its own right that both should be treated separately. Rather than split our effort, therefore, we shall concentrate on a discussion of brain dysfunction primarily because it is the field of most importance to the educator.

THE CHILD WITH MINIMAL BRAIN DYSFUNCTION

A person investigating the areas of brain dysfunction and personality disorders among children quickly begins to feel that he is shadow boxing. Clear cut facts, definitions, and statistics are hard to find. Diagnostic techniques are haphazard and hazy. Symptomatology is far too broad and therapeutic techniques are still very much in the, "Take two aspirins and go to bed," stage. There are many reasons for this, but the basic reason is that it was only when we began to examine the field of learning and emotional disorders closely that the realization of the problem's magnitude became clear.

To use an analogy, once "Heart Disease" was considered as one illness and treated as such. But as researchers delved into the problem they began to realize just how many types of "Heart Disease" there were and how many people suffered from heart disease and how difficult it was to treat each particular aspect of "Heart Disease." At each step in the process, they found themselves faced with problems of diagnosing and treating problems they were unaware of a short time before.

Much the same case is true in the diagnosis and treatment of brain dysfunctions and personality disorders among children. As recently as twenty years ago most educators did not realize the magnitude of the problem. Children with intellectual and/or behavioral deviations of a serious nature tended to be lumped together into one large category. The treatment for non-learning tended to be more traditional classwork, while the treatment for emotional disorders was often punishment or isolation.

Time and maturity cured many of the problems experienced by children with severe deviations of intellect and behavior, but not all. There remained a group of children whose problems were not cured by class work and punishment. This hard core, as it were, began to be seen as a group possessed of certain characteristics which more or less sharply distinguished them from the rest of the group.

Such children were referred to in many ways: brain injured, brain damaged, neurologically handicapped, organic hyperkinetic child, the minimally brain dysfunctional child. Gross and Wilson, prominent psychiatrists in the field prefer the term "minimally brain dysfunctional" because the brain is not actually "damaged" in the sense of neuronal destruction, but does show evidence of neurophysiologic and neurochemical dysfunction. This term has also been accepted by the National Society for Crippled Children and Adults, Inc.

The minimally brain dysfunctional child will typically show <u>several</u>, if not all, of the following symptom clusters:

1. Emotional lability.
2. Short attention span and distractibility.
3. Inconsistency and unpredictability.
4. Impulsivity.
5. Difficulty in modulating motor activity(hyperkinesis).
6. Poor, self-concept.
7. Inability to learn from experience or respond to punishment.
8. Temper tantrums and violent rage reactions.
9. Difficulty in being "reached".
10. Lack of appropriate fear.
11. Lack of affectionateness.
12. Learning and perceptual defects.

13. Defects in muscle coordination.

14. Wide discrepancy between Verbal and Performance I.Q. on Wechsler Intelligence Scale for Children.[1]

Such children may be mentally retarded also; they normally are not. In point of fact they are so very normal in so many ways that it is often impossible for even an experienced psychiatrist to make a correct diagnosis.

BACKGROUND OF CURRENT STUDIES OF MINIMAL BRAIN DYSFUNCTION

The growing importance of the field of minimal brain dysfunction has become more evident in recent years, as both government and prestigeous private institutions have invested heavily in research and study within this area.

On August 22, 1963, in Washington, D.C. the National Society for Crippled Children and Adults, Inc., in cooperation with the Neurological and Sensory Diseases Service Program of the Division of Chronic Diseases, U.S. Public Health Service, sponsored a steering committee meeting to develop a symposium on the "Child with Minimal Brain Dysfunction."

As an eventual outgrowth of that meeting it was decided to set up three task forces to explore the following major areas:

<u>Task Force I - Terminology and Identification</u>

Define problem.

Suggest nomenclature.

Identify child.

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[1]Mortimer D. Gross and William C. Wilson, "Diagnosis and Treatment of Behavior and Learning Disorders of Childgood Associated With Minimal Brain Dysfunction," unpublished article, (November, 1965). pp. 1-3.

Delineate relationship of this problem to other handicaps.

Outline diagnostic criteria.

Task Force II - Services

Extent of need:

For medical diagnosis and treatment.

For identification of educational capabilities and methods of educating afflicted children.

Availability: In medical centers? In public schools?

What services from a practical viewpoint should be made available?

What should a public information program include to acquaint the community with the problem?

Task Force III - Research

Applied research.

Basic research.

In August, 1964, Dr. Sam D. Clements was appointed Project Director of the Task Force I Committee designed to explore Terminology and Identification. On the committee were eleven other prominent experts in the field of minimal brain dysfunction.

As a result of that committee meeting, Task Force I for the study of minimal brain dysfunction came into being. Funding was carried out by federal and private agencies acting in concert.[2]

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[2] Sam D. Clements, Minimal Brain Dysfunction in Children("Public Health Service Publication," No. 1415; Washington, D.C.: U.S. Government Printing Office, 1966), pp. 3-4.

The intensive study of minimal brain dysfunction carried out by this group culminated in the printing of a small, but comprehensive monograph entitled, "Minimal Brain Dysfunction in Children." The monograph (NINDE MONO. No. 3) was published by the Public Health Service early in 1966 and does a succinct job of tying together the loose ends and pointing the direction for further studies.

This one short pamphlet holds a position of authority in the field much beyond its physical size, due to its breadth and the prestige of its authors.

In their study Task Force I defined the term "minimal brain dysfunction syndrome" to refer to children of near average, average, or above average general intelligence with certain learning or behavioral disabilities ranging from mild to severe, which are associated with deviations of functions of the central nervous system. These deviations may manifest themselves by various combinations of impairment in perception, conceptualization, language, memory, and control of attention, impulse, or motor function.[3]

The recent rise in the interest and study of "minimally brain dysfunctioned" children which has in turn led to the identification of large numbers of children in this category may be explained at least partially on the basis of one or more of the following factors:

1. The increased refinement in diagnostic techniques and skills during the last several years.
2. The growing need for more precise classification of the learning and behavioral disorders of children.

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[3]Ibid., pp. 9-10.

3. An apparent increase in the number of children compromised by neurologic dysfunctions, perhaps the unintentional aftermath of medical advances.
4. A growing dissatisfaction on the part of many medical workers with children with purely psychogenic and interpersonal explanations for disorganized or poorly understood behavior.
5. Increased communication between educators, psychologists, and medical specialists.[4]

The history of the movement to study minimal brain dysfunction is in itself an interesting topic. Prior to 1920 the literature on minimal brain dysfunction was sparse and generally concerned with observations on individuals who sustained damage to the brain after reaching adulthood, although there are some early references to "nervous conditions" in children which affected learning and behavior.

In the period between the two World Wars many papers appeared which can be considered the descriptive forefunners of certain aspects of minimal brain dysfunction. A large number were devoted to the linkage between specific etiologic agents and resultant changes in behavior and learning abilities. The classic work of Strauss and Lehtinen marked a milestone in this development and was perhaps the most influential volume in the production of fresh

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[4]Ibid., p. 1.

Barbara Bateman, "Learning Disorders," Review of Educational Research, XXXVI(February, 1966), p. 93.

considerations in the areas of pathology, diagnosis, education, and investigation of children with learning and behavioral disabilities.[5]

Since 1950, the literature has become increasingly loaded with clinically oriented articles and studies of the disabilities under the general heading of minimal brain dysfunction in children. Among these, the recent volume by Birch[6] is particularly comprehensive. In addition, recent standard texts of child psychology, neurology, pediatrics, and psychiatry have now begun to cover this subject more thoroughly.[7]

NUMBERS AND CLASSIFICATION

In studying the literature regarding minimal brain dysfunction one is struck by the almost total lack of statistical data. One finds no data in books or articles telling how many children suffer from this problem, nor are there any references telling where such data may be found. In a quest for facts the author contacted the U.S.O.E. and the National Association for Mental Health, Inc.

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[5]Alfred A. Strauss and Laura E. Lehtinen, Psychopathology and Education of the Brain Injured Child, (New York: Grune and Stratton, 1947).

[6]Herbert G. Birch, editor. Brain Damage in Children: The Biological and Social Aspects (Baltimore: Williams and Wilkins Co., 1964).

[7]Sam D. Clements, Minimal Brain Dysfunction in Children ("Public Health Service Publication," No. 1415; Washington, D.C.: U.S. Government Printing Office, 1966), p. 5.

Both organizations were unable to provide any data pertaining to the number of children involved nor were they able to indicate where such information might be obtained.[8]

This lack of information is due in part to the newness of research pertaining to minimal brain dysfunction. It is due no less to a lack of clarity on what constitutes minimal brain dysfunction. For in a very true sense how one defines brain damage determines what persons are included. Some experts would include only those with externally provable brain damage. Other experts would include almost any type of disability which inferred brain damage.

The definition of minimal brain dysfunction arrived at by Task Force I tends to the latter view. It has not however been accepted by the field generally.[9] Even if it were completely accepted it would still take time for the definition to filter down and influence basic thinking, to include the collection of statistical data.

What makes the problem of defining minimal brain dysfunction difficult is that it has both qualitative and quantitative aspects. On the qualitative side the types of disabilities which shall be included under the heading of minimal brain dysfunction must be determined.

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[8]U.S.O.E. recommended only the Task Force I pamphlet, previously cited. In a letter dated Dec. 8, 1966, the National Association for Mental Health, Inc. stated they had no data available and were unable to indicate where such data might be obtained.

[9]Barbara Bateman, "Learning Disorders," Review of Educational Research, XXXVI(February, 1966), p. 94.

On the quantitative side of the spectrum, it is necessary to determine how serious a problem must be before a person is considered to have left the bounds of normalcy and arrived at minimal brain dysfunction. And again the border line between minimal brain dysfunction and severe disorder must be determined because in actuality what we call "minimal brain dysfunctions" are just less severe forms of well identified problems. To illustrate this fact, refer to chart 1, which has a two way classification guide.

Horizontally across the top of the chart we see ranged the quantitative aspects, arbitrarily divided into normal range, minimal impairment, and major impairment. In actual life there would be found a continuum rather than three categories, and that is the basic reason why it is so difficult to classify persons falling near the borderlines of either category.

The qualitative categories ranged vertically along the side of the chart indicate five general areas where dysfunction may occur. These five categories are also chosen somewhat arbitrarily and other divisions or subdivisions could be defended. As with the quantitative categories, the borderlines are often hazy.

The child with minimal brain dysfunction would exhibit minor symptoms in varying degree and varying combinations. He might have an impairment in only one of the categories indicated or he might have an impairment in two, three, four, or five of the categories. Just as with any other human abilities we would most typically find a varying profile for each person with minimal brain dysfunction. He may be average or above average in some categories and in the range of minimal dysfunctions in others.

CHART 1

EXTENT OF IMPAIRMENT[10]

Area of Impairment	Normal Range	Minimal (minor; mild)	Major (severe)
1. Movement and Coordination	Within Normal Bounds	Impairment of fine movement or coordination	Cerebral palsies
2. Brain Wave Patterns	Within Normal Bounds	Electroencephalographic abnormalities without actual seizures, or possible subclinical seizures which may be associated with fluctuations in behavior or intellectual function	Epilepsies
3. Attention, activity level, impulse control, and affective domain	Within Normal Bounds	Deviations in attention, activity level, impulse control and affect	Autism and other gross disorders of mentation and behavior
4. Perception, intelligence, memory	Within Normal Bounds	Specific and circumscribed perceptual, intellectual, and memory deficits	Mental subnormalities
5. Vision, hearing, speech, haptics	Within Normal Bounds	Nonperipheral impairments of vision, hearing, haptics, and speech	Blindness, deafness, and severe aphasias

[10]Sam D. Clements, Minimal Brain Dysfunction in Children("Public Health Service Publication," No. 1415; Washington, D.C.: U.S.Government Printing Office, 1966), p.10.

It is unfortunate that due to the newness of the field, more specific categories cannot be determined. However, it is more than likely that as the categories of dysfunction are more clearly stated and empirically tested, more reliable statistics will be developed.

At the present time, common estimates hold that five to fifteen percent of the school population have serious difficulty in reading, two to ten percent have speech problems, and twenty to thirty percent have less-than-adequate motor development. To these groups could be added the slow learners, aphasoid, disturbed, visually handicapped, etc. The total included within these categories could well add up to more than fifty percent of the school population which potentially could suffer from some form of minimal brain dysfunction.[11]

Hopefully, the actual figure is much lower than this, especially inasmuch as some children would fall into more than one category of learning disorder. But it is useless to speculate until more reliable measures are found. One of the greatest problems in classification is the lack of a single quantitative measure of minimal brain dysfunction. Measures like I.Q., grade scores, visual acuity, or decibel level, although they have faults, are reasonably objective and can be used in delineating certain groups of exceptional children. But there is no equivalent measure for minimal brain dysfunction in even one of the categories designated.[12]

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[11]Barbara Bateman, "Learning Disorders," Review of Educational Research, XXXVI (February, 1966), p. 95.

[12]Ibid.

SYMPTOMATOLOGY

In an earlier portion of this chapter we discussed in general some of the characteristics often connected with a child who has minimal brain dysfunction. The list we cited however was by no means exhaustive. Task Force I has prepared a compendium in an attempt to develop a scheme for classification of the symptoms. The entire classificatory scheme included fifteen major categories with eighty-nine subcategories ranged beneath them. The categories cover every possible portion of a child's life from Test Performance to Disorders of Attention and Concentration. This classification of symptoms represents a forward step in the field of minimal brain dysfunction and is included, in toto, as an appendix to this study.[13]

One serious objection to this categorization of symptoms has to do with the method in which the specific symptoms were collected. No real attempt was made to determine the validity of the symptoms gathered. They were merely "lifted" from various studies done in this field and fitted into the proper general category, with a new general category being created where applicable. Some opposing characteristics were dropped, together with general or judgmental characteristics, in a general sorting process. However all those symptoms which fit into the general logical framework were kept. It may be that some of the symptoms are false or ambiguous. It is also obvious that the Task Force has lumped together a large number of specific symptoms for similar

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[13] Sam D. Clements, Minimal Brain Dysfunction in Children("Public Health Service Publication," No. 1415; Washington, D.C.: U.S. Government Printing Office, 1966), pp. 11-13.

See Appendix I

(but not necessarily identical) disorders and put them under a large sign that says, "Minimal Brain Dysfunction". It is in effect an admission of how little is known about the true causes and symptoms of the field.

The two categories of symptoms contained in that compendium which are of most importance to the current study are those dealing with Test Performance and Impairments of Perception and Concept - formation, reproduced below for easy reference.

A. Test Performance Indicators

1. Spotty or patchy intellectual deficits. Achievement low in some areas; high in others.
2. Below mental age level on drawing tests(man, house, etc.).
3. Geometric figure drawings poor for age and measured intelligence.
4. Poor performance on block design and marble board tests.
5. Poor showing on group tests(intelligence and achievement) and daily classroom examinations which require reading.
6. Characteristic subtest patterns on the Wechsler Intelligence Scale for Children, including "scatter" within both Verbal and Performance Scales; High Verbal - Low Performance; Low Verbal - High Performance.

B. Impairments of Perception and Concept - Formation

1. Impaired discrimination of size.
2. Impaired discrimination of right - left and up - down.
3. Impaired tactile discrimination.
4. Poor spatial orientation.

5. Impaired orientation in time.

6. Distorted concept of body image.

7. Impaired judgment of distance.

8. Impaired discrimination of figure-ground.

9. Impaired discrimination of part - whole.

10. Frequent perceptual reversals in reading and in writing letters and numbers.

11. Poor perceptual integration. Child cannot fuse sensory impressions into meaningful entities.

The seventeen subcategories in the first two major categories assume special importance for our study inasmuch as nearly all seventeen will be sampled directly or indirectly by the tests used in this study. Item 3 in Category A and items 2,3,4,7, and especially 8 in Category B will be sampled by the M.P.D. It is in fact largely upon the discovery of impairments of perception in brain damaged children that the rationale for the M.P.D. test rests.

The majority of the remaining symptoms in Categories C to O(contained in appendix) while serving as important indicators of minimal brain dysfunction do not bear so directly on the current study. It should be indicated however that some of the items listed as symptoms may in fact be causes, e.g., poor adjustment to environmental changes(item 5 in Category N).

It would be easy at this point to become engrossed in research into the symptomatology of minimal brain dysfunction and continue on into all its ramifications. That however is another study and it is not our intention to cover this field exhaustively.

The purpose in discussing symptomatology at this point is to indicate merely that there is a full and complete list of symptoms connected with minimal brain dysfunction syndrome. True, this list has drawbacks, but it remains an excellent and most useful tool. While not all of the symptoms would be understandable to the lay person, the list does provide everyone from parent to doctor to educator with a means of initial identification of children suspected of having minimal brain dysfunction. It should be possible by publicizing this list and making it readily available to all persons concerned to develop a consciousness in parents, educators, and medical personnel of the needs and symptomatology of minimally brain dysfunctioned children.

Thus the early identification of possible cases is feasible.

DEFINITIVE DIAGNOSIS OF MINIMAL BRAIN DYSFUNCTION

Having once established that a person _may_ have minimal brain dysfunction, a major problem immediately looms. How do we arrive at a definitive diagnosis of minimal brain dysfuntion? The answer is, "Not Easily!" at the present time. And it is precisely for this reason that the M.P.D. was developed.

The current guidelines advocated by Task Force I for the diagnostic evaluation of deviating children include the following:

A. Medical Evaluation

   1. Histories:

      a. Medical - to include pre-, peri-, and postnatal information.

      b. Developmental.

      c. Family - Social.

2. Physical Examination:

    a. General, complete.

    b. Neurologic, complete.

3. Special Examinations:

    a. Ophthalmologic.

    b. Otologic.

4. Routine Laboratory Tests:

    a. Serologic.

    b. Urinalysis.

    c. Hematologic.

5. Special Laboratory Tests(As indicated).

    a. Electroencephalographic(Wake, sleep, and serial tracings).

    b. Radiologic.

    c. Pneumoencephalographic.

    d. Angiographic.

    e. Biochemical.

    f. Genetic assessment: Chromosone analysis.

B. <u>Behavioral</u> <u>Assessment</u>.

1. Academic History.

2. Psychological Evaluation.

    a. Individual comprehensive assessment of intellectual functioning.

    b. Measures of complex visual-motor-perceptual functioning.

    c. Behavior observations.

    d. Additional indices of learning and behavior as indicated.

3. Language Evaluation.

To include audiometric screening; assessment of articulation, etc.

4. Educational Evaluation, Complete.[14]

The guidelines above were not printed as filler to lengthen this study. They were included to point out the latest thinking by the foremost experts in the field on the diagnosis of minimal brain dysfunction.

I humbly submit that even if a child did not have minimal brain dysfunction before he started, he just might have after going through a process like this. Or he might at least wish he did, after his parents get the bill.

On a practical level, a child enrolled in a public school whose parents have access only to public or semipublic facilities for diagnosis would have to wait a minimum of a year to complete this process. If the parents had money and immediate access to clinical facilities, a complete work-up such as this would normally take from three to six months, as a conservative estimate.

And what would Dad have to show for his expenses and the child for his aggravation? Quite often nothing. Gross and Wilson have this to say about children with minimal brain dysfunction:

"These children are not mentally defective; they display no gross neurological defects; they do not for the most part have epilepsy nor is their behavior disorder paroxysmal in nature, and in most cases, they show no evidence of psychosis. Diagnostically the more common psychological tests are

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[14]Ibid., pp. 14-15.

disappointing in that they frequently do not reveal any gross signs of organic disorder and sometimes give hardly a hint of organicity. The physical examination is usually negative. The psychiatric mental-status examination is often - and we must emphasize this - unrevealing, for these children are typically well integrated in a one-to-one situation where they may appear as charming, outgoing children; in fact, the major difficulty in diagnosing these children is that they look so normal. Positive psychiatric findings may be limited to only the more severely affected of these children."

They continue on to say, "Essentially, the diagnosis is reached by anamenesis, aided by the electroencephalogram(EEG), which usually reveals a subconvulsive cerebral dysrhythmia, and by more refined psychological tests. Special psychological tests, more specifically diagnostic of perceptual, conceptual, language and motor handicaps, are helpful; these include the Wechsler Intelligence Scale for Children, Illinois Tests of Psycholinguistics, Bender-Gestalt, Wepman Auditory Discrimination Tests. No test pattern, however, appears to be actually diagnostic of minimal brain dysfunction.

"As a diagnostic tool, the electroencephalogram is invaluable. In the absence of any history of convulsions, most of these children show an EEG abnormality, especially when the EEG is taken with unipolar leads. There is no specific abnormality characteristic of these children, but probably the most common is 14 and 6/second positive spikes found usually in one or the other temporal lobe in sleep. (For this reason, any negative EEG without a sleep record must be considered valueless.)

"Other common EEG abnormalities are 6/second positive spikes, spike and 6/second wave patterns, negative temporal spikes, as well as many of the patterns found in grand mal, petit mal, and psychomotor epilepsy."[15]

Most practicing psychiatrists and clinical psychologists agree to the difficulty of obtaining a clear diagnosis of minimal brain dysfunction. They are joined in this conclusion by the director of every child guidance center to which the author has spoken. However, they are confident that a diagnostic procedure such as that outlined earlier will normally result in a correct diagnosis, but assert that there is no certitude. This is due in part to the cloudy nature of minimal brain dysfunction itself. They are all agreed that at least at the present time there are no proven short cuts to diagnosis.[16]

It is precisely because of the fact that minimal brain dysfunction is so difficult and expensive to diagnose that the M.P.D. assumes so much importance. In chapter II we shall closely examine the claims and proofs offered in behalf of the validity of the M.P.D. For the present we shall merely point out that the M.P.D. test can be administered in six minutes and

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[15]Mortimer D. Gross and William C. Wilson, "Diagnosis and Treatment of Behavior and Learning Disorders of Childhood Associated With Minimal Brain Dysfunction," unpublished article,(November, 1965). p.4.

[16]Barbara Bateman, "Learning Disorders," Review of Educational Research XXXVI(February, 1966), pp. 93-119.

Sam D. Clements, The Child With Minimal Brain Dysfunction, A Report Presented to the 1963 Annual Conference of the National Society for Crippled Children and Adults, Chicago, 1963, Prepared by the National Society for Crippled Children and Adults(Chicago: Easter Seal, 1963), p. 12.

Interviews with Dr. Jean McCarthy, Dr. Hirschoren, etc.

scored in ten minutes or less. And while it has not been perfected yet, it has shown great promise in the identification of children and adults suffering from brain damage and/or severe personality disorders.

The M.P.D. will probably never be able to replace a complete examination for definitive diagnosis. In fact it might be very undesirable to do so. However, it might, upon refinement, make an outstanding screening procedure. Its correct usage, in addition to aiding in definitive diagnosis, could make possible the early identification of children suffering from minimal brain dysfunction or severe emotional disorders. The M.P.D. could in fact lead to the identification of many children with no outward symptoms at all, the child who normally "gets by" but who needs help to achieve his full potential.

It is from this one basic fact that the importance of the M.P.D. springs. And it is because of the potential importance of the M.P.D. that this study has been initiated to give a deeper understanding of how and why the M.P.D. works and what it is measuring that seems to give it such high concurrent validity.

TREATMENT OF MINIMAL BRAIN DYSFUNCTION

Once a definitive diagnosis has been arrived at, it is possible to begin treatment. There are differing points of view as to the best type of treatment for children with minimal brain dysfunction. Some practitioners prefer to use medication, some psychotherapy, and some educational planning. The method of treatment preferred by most experts is to try medication first, either with or without an accompanying educational and counseling program.

The use of medication will often lead to an immediate marked improvement in a large number of children, whether or not the use of such medication is accompanied by a planned educational program. The advantages of pharmacotherapy are that it is simple, inexpensive, and often dramatically effective. At times pharmacotherapy may provide definitive treatment and nothing more need be done.[17]

Most often it is accompanied by a planned program taking into account the child's home and school environment. The use of medications should be undertaken only by an expert and constant and consistent follow up is essential. The range of medications available however is quite large and appropriate to a large variety of cases.[18]

Gross and Wilson state that their experience indicates that about one third of the children treated showed an excellent response to pharmacotherapy alone, one third a fair response, and one third showed little or no response. They also state that the side effects of anorexia, jitteriness, and sleep-

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[17]Sam D. Clements, The Child With Minimal Brain Dysfunction, A Report Presented to the 1963 Annual Conference of the National Society for Crippled Children and Adults, Chicago, 1963, Prepared by the National Society for Crippled Children and Adults(Chicago: Easter Seal, 1963), p. 13.

Mortimer D. Gross and William C. Wilson, "Diagnosis and Treatment of Behavior and Learning Disorders of Childhood Associated With Minimal Brain Dysfunction," unpublished article, (November, 1965). p. 5.

[18]Typical drugs used include captodiamine hypochloride, thioridazine hydrocholoride, and the amphetamines, especially dextro-amphetimine and racemin-amphetimine.

lessness are rare.[19] It must be pointed out however that not every practitioner in the field is convinced of the efficacy of medications.[20]

Even in those cases where the only treatment undertaken is the use of drugs, both the parents and the school should be made aware of and led to an understanding of the problem. Telling them what to normally expect of a minimally brain dysfunctioned child and providing simple guidelines will often assure the child of a satisfactory adjustment.

In those cases where pharmacotherapy is inadequate by itself, additional treatment aimed basically at the child's home and scool life are instituted. The first step in assisting the child's parents to cope with the problem is explaining to them the nature of minimal brain dysfunction and relieving their guilt. After this, there are many positive steps that can be taken. A high degree of structure in home life is encouraged with an emphasis on controls and a de-emphasis on punishment. Games, exercises, and other "gimmicks" are available, but sets of guidelines detailing how to structure the child's home life are most valuable.

The first step in working with the school is to see that the teacher, principal, guidance counselor, and other appropriate personnel are involved in the treatment program and understand the situation. Simply identifying the

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[19]Mortimer D. Gross and William C. Wilson, "Diagnosis and Treatment of Behavior and Learning Disorders of Childhood Associated With Minimal Brain Dysfunction," unpublished article, (November, 1965), pp. 5 - 6.

[20]In an interview, Dr. Jean McCarthy, Director of Special Education, District #54, Schaumburg, Ill., and consultant to U.S.O.E. on Special Education stated that in her experience, drugs had proven to be of a very limited value.

problem often enables the teacher to cope adequately with the child. Then an approach to the problem is normally made along four lines:

1. Control of Attention and Misdirected Activity through a Structured Environment. The social, visual, and auditory stimulations of the usual classroom are minimized. Class size is small and all possible distractions eliminated. Clear cut rules and procedures are established and rigorously adhered to.

2. Building Competence through Adjusted Tasks and Presentation: The child's lessons are short, interesting, varied, and set to his ability. Practice is spaced, skills are presented one at a time, and additional time provided for mastery.

3. Improvement of Deficit Functions: Specific programs are provided according to the pattern of weakness or deficit of the individual child. Activities include use of picture puzzles, constructions of designs with pegs, different shaped blocks or tiles, materials such as the Frostig set, etc.

4. Mastering Scholastic Skills: Programs are developed which provide extra practice, more structuring, and other special measures in the areas where the child is weak.[21]

In addition, education of the community at least in a general way is also essential.

The response of most children to a program of medication and/or educational and home planning is such that psychotherapy is seldom prescribed in

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[21]Laura E. Lehtinen, A Plan for Education, A Report Presented to the 1963 Annual Conference of the National Society for Crippled Children and Adults, Chicago, 1963, Prepared by the National Society for Crippled Children and Adults(Chicago: Easter Seal, 1963), pp. 20-22.

cases of minimal brain dysfunction. Counseling of the child, parents, teachers, etc. is however an important part of the program. The percentage of persons responding favorably on a national basis to programs such as the one described is unknown because of a lack of statistics. However, most workers in the field believe that almost every child can be helped to at least some degree. In many cases, the problem has been almost completely controlled.[22]

We can see therefore that the case of the child with minimal brain dysfunction is not hopeless. Much can be done for such children at present and hopefully even more can be done in the future. Thus, we are not seeking to identify children with minimal brain dysfunction just for the sake of gathering statistics. Once identified, they can be helped.

SEVERE PERSONALITY DISORDERS

Although the major emphasis in this study has been on minimal brain dysfunction, it is important to realize that the M.P.D. claims to be able to diagnose personality disorders such as psychosis and severe neurosis. As we shall discuss in greater detail in Chapter III, there has been some research which indicates a high degree of concurrent validity for the M.P.D. in the diagnosis of personality disorders.

Four and one half million children, one out of every ten, need psychiatric treatment, according to a recent report by the Senate subcommittee on juvenile delinquency. Among these would be included the 600,000 children

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[22]Interview with Dr. Jean McCarthy, Dr. Hirschoren, and several psychiatrists.

annually classed as delinquents.[23] This figure represents an estimate of course, but in the area of personality disorders, a good projected estimate is the best we have.

Another common estimate, which agrees with the Senate's figures, is that one in ten Americans will at some time suffer from some form of mental illness. As far as facts are concerned we know that approximately ten million persons in the United States currently suffer from mental illness and 250,000 new patients enter mental hospitals each year. The number of patients per 100,000 population in the U.S. has fluctuated from between about 300 to 400 from 1931 to the present.[24]

From these facts we can infer that a given percentage of children have full blown personality disorders. We can also infer with little fear of contradiction that an even larger number of adults with severe personality disorders had their problems start when they were children.

The symptoms of severe personality disorder are many and varied in accord with the varied nature of personality disorders. Listed below however are some of the more common categories of severe personality disorders with a short statement of the symptoms.

I Neurosis:

1. Anxiety neurosis involves mental and physical symptoms caused by

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[23] Educational Recaps, Editor Ann Z. Smith, Vol. VI, No. 4(January, 1967), p. 3.

[24] Roy R. Grinker(Reviewed by W. C. Menninger), "Mental Illness," The World Book Encyclopedia, ed. Robert Zeleny, Vol. XIII(1965), p. 328.

the abnormal fear or dread of death, insanity, or other conditions that could destroy the individual.

2. Conversion hysteria causes physical symptoms such as paralysis, numbness, and even convulsions.
3. Depressive reactions include "blue" and sad feelings, lack of decision, loss of appetite, and feelings of being inadequate to face life.
4. Hypochondria is an overconcern for symptoms or diseases that do not exist.
5. Obsessive and compulsive neuroses cause repeated urges to perform certain acts.
6. Phobias involve unreasonable fears about objects and situations, such as a fear of high places.
7. Character neuroses include passiveness, aggressiveness, moodiness, and elation.

II Psychopathic Behavior:

Psychopathic personality is found in persons who repeatedly perform unsocial acts, and do not learn from their experience. This kind of disorder can rarely be treated successfully.

III Psychoses:

1. Manic-Depressive psychosis involves periods of mania(elation) and depression(blueness).
2. In melancholia a person may have difficulty sleeping and eating. He may lose weight, and even try to commit suicide.

3. In catatonic schizophrenia, a person may become completely inactive and immobile, and not seem to respond to reality. His muscles may become rigid and he may stay in one position for hours.

4. A hebephrenic schizophrenic person talks and acts in an irrational manner.

5. A paranoid schizophrenic believes that other persons persecute him and he behaves accordingly.

6. A simple schizophrenic is emotionally dull, withdrawn, and isolated.

7. Paranoia - such persons show megalomania, or an exaggerated degree of self-love. They believe that other people act hostile and persecute them but seem to be able to behave properly.[25]

The diagnosis of a severe personality disorder ideally involves a set of diagnostic procedures much the same as those used to diagnose severe personality disorders. To this procedure would be added two major elements:

1. A psychiatrist would have an interview or series of interviews with the person, his family, friends, and associates. During these interviews he would normally use those techniques unique to the school of psychiatry to which he subscribes.

2. Typically the psychiatrist would be aided in his diagnosis by a clinical psychologist who would test and measure a wide variety of behavior

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[25] Ibid., pp. 330-331.

and mental reactions. Projective techniques such as the Rorschach Ink-Blot Test and the Thematic-Apperception-Test are widely used.[26]

As with the minimally brain dysfunctioned child it is precisely at this point that the M.P.D. test could prove invaluable. For if mental illness could be detected easily and quickly through a test such as the M.P.D., it could lead to much earlier detection of mental illness.

Personality disorders would be treated through such techniques as psychotherapy, psychoanalysis, drug therapy, shock treatment, lobotomy, physiotherapy, hypnosis, group therapy, play therapy, and psychodrama.

There are no accurate statistics on the rate of recovery for children suffering from serious personality disorders for a variety of reasons beyond the scope of this study. However, two experts with whom the author communicated were not optimistic about the percentage of children recovering.[27] It must be pointed out however that they were discussing children with full blown problems.

There remains the hope that if the problem were discovered early enough, it would not become serious. But at any rate, discovering such children would lead to their segregation from normal society and prevent them from harming themselves or others.

In summary then we would have to say that mental illness is a serious problem in the U.S. today. The M.P.D. test could play a major part in the

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[26]Ibid., pp. 331-332.

[27]Dr. Jules Masserman, Northwestern Univ., and Dr. Hirschoren, DePaul Univ. Several other psychiatrists concurred, but some felt there was hope if the child could be placed in a new environment conducive to his mental health.

early detection of serious personality disorders. While it might not reduce the dimensions of the problem it could lead to earlier treatment of children and adults whose problems might otherwise lead to even more serious consequences for themselves and others.

STUDY OVERVIEW

At this point, having shown in some detail both the need for and the function of a simple diagnostic and screening tool to aid in the early detection of minimal brain dysfunction and severe personality disorders we shall turn to a discussion of the Minnesota Percepto-Diagnostic Test. The M.P.D. is a recently developed test (1963) which has shown a high degree of concurrent validity. In Chapter II we shall explore in depth all pertinent research connected with the M.P.D. What these studies have to say however is that the M.P.D. seems to have the capability of differentiating between normal persons and persons with organic brain damage or severe personality disorders. (In addition, the M.P.D. test also showed promise of diagnosing less serious personality disorders.) Within the bounds of these studies, it was able to discriminate correctly in 80% or more of the cases.

Should the M.P.D. prove to be as effective at indicating persons with brain damage or personality disorders in the field as it has been in experimental studies, it would serve a definite need in modern life, because of the current lack of valid screening instruments in this area. And with its relative ease of administration and scoring it could make a tremendous impact in the burgeoning field of special education. There are no two ways about it, an instrument such as the M.P.D. claims to be, is needed.

Before the M.P.D. could be used in the field on a wholesale basis however, two questions would have to be answered:

1. What is the predictive validity of the M.P.D. in actual field use?

2. What is the M.P.D. measuring?

Both questions must be answered eventually. This study shall seek an immediate, if partial, answer to question two. We shall try to answer the question by discovering the relationship between the M.P.D. and a series of currently defined intellectual, perceptual, personality, and scholastic factors as measured by evaluation instruments now in use at the third grade level.

In phase one of the study, we attempted to determine the relationship between the M.P.D. and common intellectual and perceptual factors by compiling the correlation coefficients between the scores made by a sample of 150 third grade students on the M.P.D. test and the scores made by that sample on the following tests and subtests:

1. Lorge-Thorndike Intelligence Test --Total Score
2. Lorge-Thorndike Intelligence Test - Verbal Score
3. Lorge-Thorndike Intelligence Test - Non-Verbal Score
4. Frostig Developmental Test of Visual Perception - Total Score
5. Frostig Developmental Test of Visual Perception - Eye-Motor Coordination
6. Frostig Developmental Test of Visual Perception - Figure-Ground Discrimination
7. Frostig Developmental Test of Visual Perception - Form Constancy

8. Frostig Developmental Test of Visual Perception - Position in Space
9. Frostig Developmental Test of Visual Perception - Spatial Relations
10. Raven's Standard Progressive Matrices
11. Primary Mental Abilities Test - Total
12. Primary Mental Abilities Test - Verbal Meaning
13. Primary Mental Abilities Test - Spatial Relations
14. Primary Mental Abilities Test - Number Facility
15. Primary Mental Abilities Test - Perceptual Speed

By a comparison of correlation coefficients found between the M.P.D. test and the other fifteen tests and subtests we hope to be able to infer the degree of relationship between the factors measured by each.

After determining the individual correlations between all sixteen factors we shall seek to answer the question:

Of the fifteen tests and subtests correlated with the M.P.D. which four or five are most capable of predicting a score on the M.P.D. through the use of regression weights determined by Mult. R. Equation?

The answer to this question shall be obtained through an inspection of the Beta coefficients, the "b" weights, and the portion of variance predicted by each of the sixteen factors. These statistics are obtained through computerized computational techniques designed to yield a Mult. R.

After singling out the five most promising measures, we shall then seek to answer these questions:

1. What size Multiple "R" can be computed from these five tests and/or subtests?
2. What percentage of the variance on the M.P.D. can be accounted for by means of the factors measured by our five tests and subtests selected?
3. Can an efficient prediction table be derived through the use of these 5 measures?
4. What is the significance level of a Mult. R. derived from these five variables?

The answer to these questions shall be sought through statistical analysis of the data by means of a computer program which will yield most of this information in connection with the calculation of the prediction table.

The null hypothesis we shall assume is that there is no significant correlation between the M.P.D. and any single test or group of five tests and/or subtests.

Upon finishing Phase I of the study we shall then seek to answer these questions in Phase II:

1. What is the extent of and the significance of the relationship between extreme scores on the M.P.D. and scores of reading ability and study skills as measured by the Iowa Test of Basic Skills?
2. What is the extent of and the significance of the relationship between extreme scores on the M.P.D. and a set of personality traits as measured by the California Test of Personality?

The answers to these questions shall be sought by application of the X^2 technique to a sample made up of all persons 1 standard deviation above and below the mean on the M.P.D. in our original sample of 150.

Then, in order to find any significant relationships, the data will be subjected to closer analysis. The Chi-Square technique will be retained, but the sample will be enlarged and the test categories subdivided to gain greater precision.

The null hypothesis shall be that there is no significant relationship between a score on the M.P.D. and a score on the Iowa Tests of Reading and Study Skills or the California Test of Personality.

In essence what this study seeks to do is to determine which, if any, of the measures considered in this study are significantly related to a score on the M.P.D. either individually or as a member of a subgroup of scores. It is the further intent of this study to discover what portion of the variance can be accounted for by the intellectual, and perceptual factors measured by the tests and subtests used.

From this information, an attempt shall be made to infer the number and type of factors which contribute to a person's score on the M.P.D. In this way we would be able to discover indirectly what factors the M.P.D. is measuring. Should a significant and high relationship be indicated between a score on the M.P.D. and a score on one of the other measure(s), we could infer that either:

1. The factors correlation highly with the M.P.D. scores are contained within that group of factors essential to success on the M.P.D. and thus may be considered intrinsic factors or;

2. A common group of factors are at work contributing to success and/or failure in all correlated tests and we have proven that the same factors are needed for success in both the subtest(s) involved and the criterion, the M.P.D. test.

There are of course very important and practical reasons for obtaining this information. Ultimately it will help to determine the worth of the M.P.D. as a diagnostic and/or screening device in the field of minimal brain dysfunction and personality disorders. More specifically, it will tell us if the M.P.D. is measuring something already known and testable or if it is measuring "something different;" a "something different" directly related to brain damage or personality disorders.

CHAPTER OUTLINES

In chapter one we have sought to outline and delimit the exact nature of our problem. Beginning with a general background of the field of brain damage and personality disorders, we went on to indicate exactly where this study fits into the overall perspective. It was indicated that the M.P.D. is an instrument designed to diagnose brain damage and serious personality disorders. The importance of this function as well as the high concurrent validity of the M.P.D. was emphasized. We then proceeded to point out that the basic purpose of our study was to gain further information on what factors the M.P.D.did or did not measure. With this information the date at which the M.P.D. could be used(or discarded) as a diagnostic and screening tool could be advanced immeasurably.

In line with the basic purpose of the study, several specific questions which we hope to answer were also posed and the general methods of gaining and processing data outline.

Chapter two includes a short review of current perception theory with the emphasis on visual perception. A history of the Bender-Gestalt Test from which the M.P.D. derived will be included, to be followed by detailed review of all literature dealing with the rotation of figures on the Bender test. All current studies available on the M.P.D. will also be reviewed at that point, together with the pertinent literature available on the Frostig test.

The factorial pureness of all psychometric measures to be utilized in this study will then be discussed in full, to be followed by a summary of the limitations of all studies on the M.P.D. to date.

The precise experimental procedure to be followed will be covered in Chapter three. This will include a population and sample description and an outline of the data collection methods to be employed. Also included in Chapter three will be a statistical description of the tests to be used in this study with emphasis on their validity and reliability.

In Chapter four, the experimental data derived by testing our sample shall be discussed. The distributions of scores on the Lorge-Thorndike, M.P.D., P.M.A., Progressive Matrices, and Frostig test will be obtained and then graphically plotted. In addition, the means, standard deviations, and standard error of the mean shall be calculated for each of these measures.

The experimental data will be further processed in Chapter five. Here correlations will be run between the scores obtained by the sample on the Lorge-Thorndike and Progressive Matrices and their M.P.D. scores. The correlation between the Lorge-Thorndike scores and the Progressive Matrices scores will also be noted. Pertinent implications covering the correlational data between all three measures will be drawn as a means of indicating the relationships between them.

In Chapter six a correlation matrix including the subtests and total scores on the Frostig and P.M.A. test, and the M.P.D. scores will be computed. On the basis of the correlations found between these measures, implications will be drawn regarding the relationships between them.

The statistical analysis of the correlational data will be continued in Chapter seven where a Multiple R will be computed first through the use of all fifteen predictor variables and later through the use of the four or five most promising predictor variables. Computer programs will be used to yield the beta coefficients, "b" weights, and the portion of variance predicted from each predictor in addition to the Multiple R. Prediction tables will be set up if appropriate.

A different method of analysis will be undertaken on a new set of data in Chapters eight and nine. At this point all persons in our sample scoring + -1 standard deviation beyond the mean on the M.P.D. will be administered the California Test of Personality. The scores on the personality scale together with the achievement test scores in reading and work study skills made by each group will then be compared for significance by means of the Chi-Square technique.

The results of the comparison of the C.T.P. scores with the M.P.D. scores will be discussed in Chapter nine while the relationships found between the M.P.D. and the reading and work study skills will be handled in Chapter eight.

Additional analysis by means of the Chi-Square technique will also be performed on both sets of data with the size of the sample being enlarged and test categories subdivided.

In Chapter ten an overview of the problem will be presented with a summary of all pertinent findings. These findings will be used to form conclusions and formulate answers to the questions we posed earlier in Chapter one. After answering all the specific questions, an attempt will then be made to determine the overall implications of the current study for current educational practice. In line with these implications, recommendations will be made for further research to continue the work started in this study.

If appropriate, recommendations for improving current practices in the use of the M.P.D. will also be made.

CHAPTER II

REVIEW OF RELATED RESEARCH

THE NATURE OF PERCEPTION

There are about as many definitions of perception as there are books and articles on the subject. The definition that seems to make the most sense however is one given by Kobler. According to Kobler, perception is the process by which a person, "gets so he can tell one thing from another."[1]

In a very rough sense, perception takes the sense impressions supplied by our sensory modalities and converts them into integral and understandable wholes upon which our cognitive abilities may work. It serves as an intermediary between our senses and our intellect, or so most (not all) psychologists would agree.

Now defining perception in this manner is taking the coward's way out. But at least it is not without precedent. Frostig says, "the definition of perception, like that of intelligence, must at the present time be an operational one,"...because.... "The concept of perception, like other psychological concepts, is fuzzy at the boundaries."[2]

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[1]Frank J. Kobler, "Perception," The World Book Encyclopedia, ed. Robert Zeleny, Vol. XV(1965), p. 252.

[2]Marianne Frostig, "Visual Perception in the Brain Injured Child," American Journal of Orthopsychiatry, Vol. XXXIII(July 1963), p. 665.

However, even in a simple definition such as ours, several facts immediately jump out:

1. Perception is a process.
2. The process involves "something out there" in the world around us.
3. Perception implies a perceiver.
4. The process is an active one. It involves integration of specific elements to form a percept and discrimination between essential and non essential elements of that percept.
5. Perception builds upon sense impressions.

Theoretically perception operates through all sense modalities. Practically, most research thus far has been concerned with visual and auditory perception. Visual perception is the concern of our present study, although we do not negate the importance of perception through other sense modalities.

In terms of breadth, the term perception may be applied to a wide variety of processes that differ along several continua:

1. Percepts may vary in complexity from simple physical dimensions, through objects and events, to meanings and values.
2. Perceptual experiences may vary from the purely objective to the realm of imaginal phenomena.
3. The speed of the process may vary, from immediate to slow.
4. The extent of individual differences differs greatly.[3]

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[3]N. L. Gage, "Perception," Encyclopedia of Educational Research, ed. Chester W. Harris and Marie R. Liba, 3rd. Edition(1960), p. 941

When we add the perceiver and object (event, etc.) perceived to the wide variety of perceptual processes possible, the complexity of handling a concept such as "perception" becomes even more apparent. And the problems inherent in fromulating a theory (hopefully based on fact) comprehensive enough to explain all phenomena are clearly seen. But before getting into theory, it's essential to explore another dimension of perceptual phenomena and examine the outcomes of perceptual processes.

Perceptual phenomena, whether the product of sight, hearing, or another sensory modality possess certain characteristics in common. Among them would be included:

1. Quality and Dimension.
2. Configuration.
3. Constancy.
4. Frame of reference.
5. Object and event character.
6. Set and Expectancy effect.
7. Intervention of perceptual processes between sensory stimulation and phenomenal experience.[4]

Now what we have done thus far is to discuss perception in a Skinnerian manner. We have described and delineated it in concrete objective terms, in terms of what it does and the qualities it possesses. We have not attempted to explain why or how or even what a person (or other perceiver) perceives. But no one else has been able to answer these questions satisfactorily either.

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[4]Ibid.

Moreover, no current theory attempts to explain all perceptual phenomena. Rather, each orients itself toward certain problems while disregarding others.[5] As a result we have a large number of small theoretical systems, each dealing with and able to explain only a limited area in the field of perception. For example, certain psychologists have centered their investigations in the area of object configurations.

Just as there are many theoreticians in the field of perception, there are also many ways of grouping them. Taylor differentiates between theories of perception on the basis of philosophical orientation. He feels all perceptual theories are based on either nativism or empiricism. Taylor's own theory is a type of mathematical behaviorism.[6] Other writers tend to group theoreticians on the basis of whether they place their emphasis on the perceiver, the perceived, or the process.

Gage uses the categories of Physiologically Referred Theories and Non-physiological Theories as a rough means of sorting out theories. He keeps the role of perception in social psychology and education as a separate category, more or less distinct from perception in the field of general psychology.[7]

It is not the present author's intention to slight theory or deprecate its importance. However, the reader who is seriously interested in perceptual

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[5]Ibid., p. 942

[6]James G. Taylor, The Behavioral Basis of Perception(New Haven: Yale University press, 1962).

[7]N. L. Gage, "Perception," Encyclopedia of Educational Research, ed. Chester W. Harris and Marie R. Liba, 3rd Edition(1960), pp. 943-944.

theory must be referred to F. H. Allport's comprehensive survey of perceptual theories.[8] To attempt to duplicate his work, even in a cursory manner, would take us far afield. The purpose of this study is not to formulate theory, but to provide further data on which to more accurately formulate theory.

Fuller and Laird, the authors of the M.P.D., are basically Gestalt (nativist, physiologically referred) oriented in their theory of perception. They do not however speak of fields of forces, or posit a theory to explain how the brain works. They are content to describe perception in terms of objective, external characteristics. Moreover, they have limited their inquiry to a very specific aspect of perception, that is, the visual perception of two black figures on three white varying grounds.

A vast amount of empirical evidence had accumulated over the years which indicated that many persons with learning and/or emotional disorders had severe perceptual problems as indicated by their results on tasks normally posited as requiring perceptual acuity for success.

In the case of those persons having learning problems it was discovered that they often had sense modalities in good working order and average or above average intelligence. That something was missing seemed reasonable and the "something missing" was considered to be perceptual ability, either generalized or specific.

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[8]Floyd Henry Allport, Theories of Perception and the Concept of Structure(New York: Wiley Book Co., 1955).

Persons with severe personality disorders (neurosis, psychosis) were also discovered to often lack perceptual acuity.[9] There is a real question here as to whether a lack of perception causes the personality disorders, or whether personality disorders cause perceptual problems. It may be that both are mutually at fault. Or a third factor (chemical perhaps) could be causing both perceptual and personality problems. But at any rate lack of perceptual acuity, as normally measured, and personality instability seem to be correlated to a significant degree.

It is important to bear in mind at this point that persons with so called perceptual problems do not differ radically from normals in most cases. In a one to one situation it can be impossible to tell that any problem exists. It is only in specific, often highly structured situations that such children give us a clue as to their perceptual handicap.

For example, a perceptually handicapped child may come to school dressed neatly, bright, and eager appearing. He is able to reach the school safely, find his room and seat. He appears to be a capable student until he picks up a book and can't read, even though his I.Q. is 120 and he has no physical defects. The teacher may think he's lazy or "goofing off" and so may his parents. It's impossible for an outsider to tell if a perceptual handicap is causing his problem or if he is "just lazy". Personality disorders are often just as difficult to diagnose.

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[9] William H. Ittelson and Samuel B. Kutash(eds.), Perceptual Changes in Psychopathology(New Brunswick, New Jersey: Rutgers University Press, 1961).

What Fuller and Laird have attempted to do therefore is to find a given set of stimuli which because of their configuration and background cause perceptual conflicts within the perceiver. The normal perceiver is able to overcome the conflict and correctly reproduce the figures. The perceptually handicapped person is not. As a result, the presentation of the stimuli for the subject to reproduce in this highly structured situation serves to discriminate between persons with normal perceptual acuity and those with below normal perceptual acuity.

The importance of this as we have pointed out, lies with the fact that a large percentage (not all) of those persons with perceptual handicaps also have learning or personality disorders. It should also be established at this point that for the purpose of this study the M.P.D. test was not used as the criterion for determining if a person had organic brain damage, a psychosis, or a neurosis. The criterion used was clinical examination and diagnosis by a team of psychologists, doctors, and psychiatrists using all tests and techniques available to them. These are the most valid criteria available in this area and by their use, the danger of validating the M.P.D. against itself is avoided.

HISTORY OF THE BENDER - GESTALT TEST

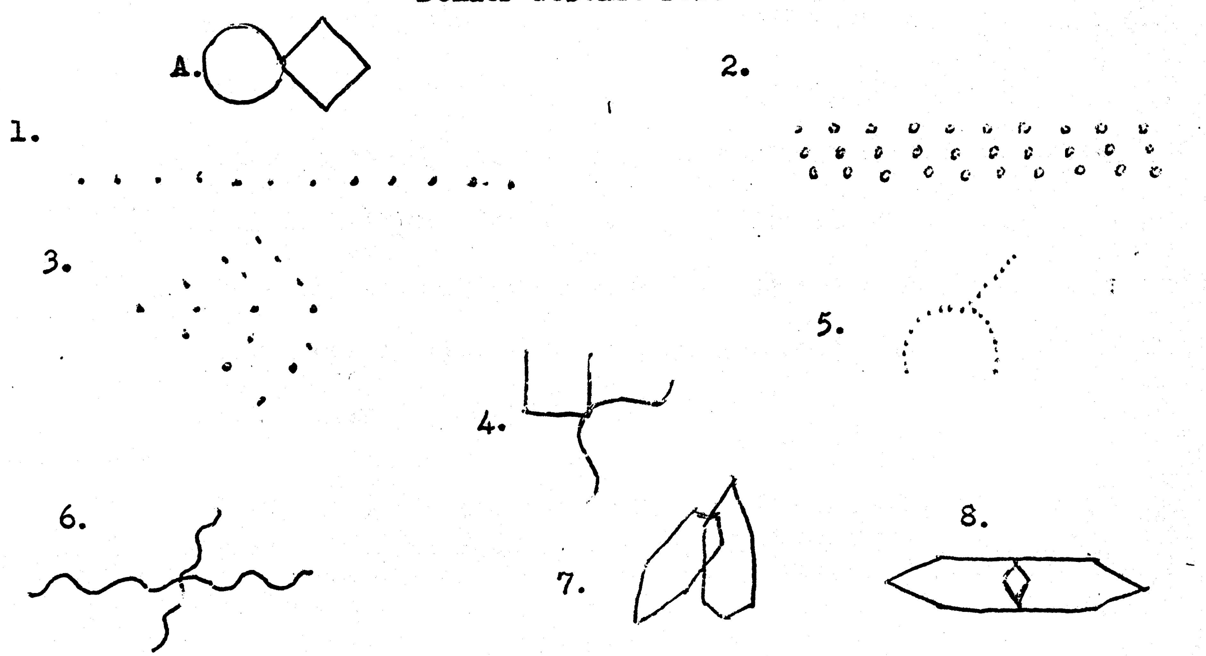
The M.P.D. test did not spring into prominence overnight in the manner of a Hollywood starlet. The development of the M.P.D. was a slow evolutionary process which began with the publication of the Bender-Gestalt test in 1938, and is still not ended. To push this point further, the Bender-Gestalt test also had its roots planted in the studies of the early Gestalt psychologists.

For in their studies is found the basic theory underlying the Bender-Gestalt test as well as the idea for the test format.

The Bender-Gestalt test consists of nine figures (Figure 1) which are presented to the subject one at a time and which he is asked to reproduce on a blank piece of paper. These designs were originally used by Wertheimer in 1923 to demonstrate the principles of Gestalt Psychology as related to perception. Bender adapted these figures for use as a visual motor test. In her original monograph she stated that the perception and reproduction of these figures were influenced by (1) the growth pattern and maturation level of an individual and (2) his pathological state either functionally or organically induced.

Figure 1

Bender-Gestalt Test



Bender goes on to describe in detail the maturation of visual-motor perceptual processes in young children, illustrating her work with actual reproductions of the Gestalt figures done by children. A chart shows that by the age of eleven, most children are able to copy all nine Bender-Gestalt designs without errors.

However, adult clinical patients were Bender's main concern and she sought to use her test with persons suffering from organic brain disorders, schizophrenia, depressive psychosis, psychoneurosis, and mental retardation. Bender did not provide an objective scoring system for her test nor any normative data. Both deficiencies have continually caused serious problems.

Over the years the Bender test has been interpreted in a variety of ways:

1. Bender suggested a developmental and clinical approach.
2. Hutt and his associates used the Bender as a projective test, interpreting the drawings in accordance with psychoanalytic theory.[10]
3. Many psychologists evaluate Bender test protocols by general clinical impressions, a very subjective technique.
4. Recently several psychologists have begun to develop more objective scoring techniques and sought to use the test as an objec- instrument.

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[10]Max L. Hutt, "The Revised Bender-Gestalt Visual Motor Test," in The Prediction of Overt Behavior Through the Use of Projective Techniques, ed. Arthur C. Carr(Springfield, Illinois: Charles C. Thomas, Publisher, 1960), XIII, pp. 30-55, 150-165.

Max L. Hutt and Gerald J. Briskin, The Clinical Use of the Revised Bender-Gestalt Test(New York: Grune and Stratton, Inc., 1960).

In terms of use, the test has been used as:

1. A test of intelligence readiness or school achievement.
2. A test for the diagnosis of brain injury.
3. An indicator of present or potential mental retardation.
4. An indicator of emotional disturbance.

Perhaps because of its adaptability to a wide range of interpretations and uses, the Bender-Gestalt is quite widely used. A survey conducted by Sundberg(1961) indicated that 158 of the 185 hospitals and agencies participating in the study used the Bender test to some degree.[11] Blakemore and Billingslea writing in the _6th Mental Measurement Yearbook_ both attest to the popularity of this test. Both also make the point that to be a valid and reliable test is in its present form impossible. Billingslea points out that not even a standard set of designs has been universally accepted.[12]

Several attempts have been made to establish scoring systems for the Bender since 1948 when Billingslea first published a rather elaborate scoring system for the test. The most widely accepted systems are those published by

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[11] N. D. Sundberg, "The Practice of Psychological Testing In Clinical Services in the United States," _American Psychologist_, XVI(1961) pp. 79-83.

[12] Fred Y. Billingslea, "The Bender Gestalt: A Review and a Perspective," _The Sixth Mental Measurements Yearbook_, ed. Oscar Buros, (Highland Park, New Jersey: The Gryphon Press, 1965) pp. 415-416.

C. B. Blakemore, "Bender Gestalt Test," _The Sixth Mental Measurements Yearbook_, ed. Oscar Buros, (Highland Park, New Jersey: The Gryphon Press, 1965) pp. 414-415.

Pascal and Suttell in 1951[13] and Koppitz[14] in 1960. Pascal and Suttell's scoring system was designed for adults 15 to 50 years of age who were basically normal. Koppitz on the other hand has developed a modification of the Pascal and Suttell scoring system for use with children.

A general survey of the literature in 1964 revealed that from 1938 to 1964 more than 130 books, studies, and papers dealing with the Bender-Gestalt test had been published.

Unfortunately while the Bender-Gestalt test had a degree of usefulness in the hands of specialized examiners, its reliability and validity were never proven. It never quite made the step from subjective tool to objective instrument, and the promise which it held was never fully realized. However in the early 1950's interest began to slowly grow in one aspect of the Bender-Gestalt test which seemed both significant and amenable to standardization. This was the area of figure rotations.

REVIEW OF LITERATURE ON BENDER - GESTALT CONCERNING ROTATIONS

The occurence of rotations in the reproduction of perceived objects whether gestalt designs or block designs has long been considered a deviation from normalcy. Because of this, such rotations have been studied for years, with the emphasis on three questions:

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[13]Gerald R. Pascal and Barbara J. Suttell, The Bender-Gestalt Test: Quantification and Validity for Adults(New York: Grune and Stratton, Inc., 1951).

[14]Elizabeth Munsterberg Koppitz, The Bender Gestalt Test for Young Children(New York: Grune and Stratton, Inc., 1964).

1. What is a true rotation?

2. What does a rotation signify?

3. How many degrees of rotation must occur before it is significant?

1. What is a True Rotation? Rotations have long been discussed but a major problem indicated by Griffith and Taylor[15] is that the variables involved may not have been controlled closely enough to insure the occurrence of only true rotations. Thus, some rotations may not have been due to perceptual distortions but to uncontrolled conditions within the experiment such as:

a. Rotating the design card in reference to the paper.

b. Rotating the paper in reference to the design card. Only when both the design card and the paper are in direct alignment can a true rotation take place.[16] As a result, every investigation in the area of rotations must be checked for control of these factors.

2. What Does a Rotation Signify? Rotations occur in a variety of categories, some pathological and some normal. For example, pre-school normal children often produce rotations seemingly as a result of immaturity, a natural cause. But when rotations are reproduced by children eight years of age or

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[15] R. M. Griffith and V. H. Taylor, "Bender-Gestalt Figure Rotations: A Stimulus Factor" Journal of Consulting Psychology, Vol. XXV, No. 1(February, 1961), pp. 89-90.

[16] Gerald B. Fuller and James T. Laird, "The Minnesota Percepto-Diagnostic Test," Journal of Clinical Psychology, Monograph Supplement, Vol. XIX, No. 16 (January, 1963), p.10.

Max L. Hutt, "The Revised Bender-Gestalt Visual Motor Test," in The Predication of Overt Behavior Through the Use of Projective Techniques, Arthur C. Carr(Springfield, Illinois: Charles C. Thomas, Publisher,1960),XIII,pp.63-65.

older, it may be a sign of brain damage, schizophrenia, emotional disturbance, or mental deficiency. Among adults, rotations also occur in different pathological groups.

In this area there are a large number of serious investigations; the majority deal with rotations on the Bender-Gestalt design or Koh's Block designs. A complete listing of studies dealing with figure rotations is included in the bibliography.

3. <u>How Many Degrees of Rotation Must Occur Before it is Significant?</u> Frankly, up to the current time there has been no real agreement as to how many degrees of rotation indicates a pathology of a given type, or a pathology in general. Clawson feels a rotation of 15° is significant,[17] but Halpin reports a rotation of 90° is necessary for significance.[18] Such differences are probably due to several factors such as subjective scoring, lack of experimental control, or failure to attempt quantification in the area of rotations. As a result, the tendency has been to regard any rotation as a malignant sign. In one highly exhaustive study Griffith found the percentage of B.G. records with one or more rotations occurred among the following groups with the frequency noted.[19]

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[17]Aileen Clawson, "Bender Visual Motor Test as an Index of Emotional Disturbance," <u>Journal of Projective Techniques</u>. Vol. XXIII, No. 2(June, 1959) pp. 198-206.

[18]Virginia Halpin, "Rotational Errors on Bender-Gestalt," <u>American Journal of Mental Deficiency</u>, Vol. LIX(1955), pp. 484-489.

[19]R. M. Griffith and V. H. Taylor, "Incidence of Bender-Gestalt Figure Rotations," <u>Journal of Consulting Psychology</u>, Vol. XXIV(1960), pp. 189-190.

Table I

Group	Sample N	Percentage with Rotations
Schizophrenic	346	19.7
Neurosis	167	19.8
Character Disorder	165	16.4
Chronic Brain Syndrome	147	40.8
Mental Deficiency	59	55.9
Other	178	23.0
Total	1,003	22.8

It must be reported that negative findings also occurred as with Halpin who, in 1955, reported no statistically significant difference in the number of rotations produced by organic and familial children.[20] Such results tended to be the exception rather than the rule however.

The amazing thing regarding studies of rotation is that prior to the introduction of the M.P.D. test, no one undertook the serious tasks of: (1) Defining a true rotation, (2) Standardizing the procedures for determining rotation, (3) Determining cutoff points, in terms of degrees of rotation, which indicate specific types of pathology. One wonders why valid research techniques were not applied to this area twenty years ago instead of five.

[20]Virginia Halpin, "Rotational Errors on Bender-Gestalt," American Journal of Mental Deficiency, Vol. LIX(1955), pp. 484-489.

At any rate the need for an instrument capable of measuring rotations accurately and interpreting their meaning become quite evident.

THE M.P.D. TEST

The M.P.D. test is a recent attempt (1962) bu Fuller and Laird to provide a group test which maintains many of the advantages of the Bender-Gestalt test but which is easier to administer and more objective to score.

"The test consists of six test figures, Figures A and 3 of the Bender-Gestalt, each presented in three ways: conventionally; on a diamond shaped card with the figure rotated 90° from the usual presentation; and conventionally on a diamond shaped card. The subject is not allowed to move the stimulus or the response sheet, and is then required to draw each of the figures. The measure derived is the amount of rotation in degrees from the vertical or horizontal axis, measured with a protractor and ruler. Scores of more than 25° are scored as 25° so that there is an imposed ceiling of 150° on the subjects' test score."[21]

The test is purported to be culture free, so education, intelligence, and reading ability, within limits, should not affect the results. When properly administered, the test, according to the authors, provides a rapid and objective means of determining whether:

a. Adults are normal; have organic brain damage or have a serious personality disturbance.

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[21] Eugene E. Levitt, "Minnesota Percepto-Diagnostic Test," The Sixth Mental Measurements Yearbook, ed. Oscar Buros(Highland Park, New Jersey: The Gryphon Press, 1965) No. 231, p. 471.

b. Children are normal; have a schizophrenic disturbance or a severe emotional disturbance.

c. A reading disability in a child is caused by organic brain damage, primary retardation, or secondary retardation.[22]

Inasmuch as the M.P.D. is a legitimate offspring of the Bender-Gestalt test, it too has its roots in the perceptual experiments of the Gestalt psychologists who emphasized perception as the basic principle in human learning. The authors make this fact clear and claim that it, together with the four following Gestalt principles, serves as rationale for their test.

Principle 1. Inhomogeneity. In order for a figure to be seen, the ground must be inhomogeneous to the figure, e.g., a picture of a black horse on a white canvas.

Principle 2. Interaction of Figure-Ground. "Variations of the ground influence one's perception of the figure so that the same figure seen against different grounds appears changed. ...For example, a square may be perceived as a diamond or a square, depending upon its spatial orientation."[23]

Principle 3. Laws of Grouping. Apart from ground, each figure has its own properties, and when certain conditions obtain between the parts, a unitary and cohesive figure is perceived.

Principle 4. Pragnanz. There is a tendency for a Gestalt to become sharply defined (precise, stable) to the extent that conditions permit.

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[22]Gerald B. Fuller and James T. Laird, "The Minnesota Percepto-Diagnostic Test," Journal of Clinical Psychology, Monograph Supplement, Vol. XIX, No. 16 (January, 1963), p. 7.

[23]Ibid., pp. 8-9.

When these conditions are met, stable figures are permitted. When they are not met, or met only partially, the cohesiveness and stability of figures are lessened. Therefore, in accordance with the above mentioned principles, there is a continuum ranging from cohesiveness and stability to ambiguity and instability for perceived figures.

Wertheimer in his research used several figures which demonstrated these properties. These figures were later adapted by Bender in the Bender-Gestalt test. Most of the figures were quite stable because the figures were congruent to the ground. Experience showed however that five of these figures were less stable than the others and more likely to appear rotated.

The five least stable Wertheimer figures were used experimentally in their normal orientation and then with the frames enclosing the figures varied, to determine which figures and what orientations produced varied rotations on the part of various groups of subjects. In essence the authors sought to discover what figures are least rotated by normals and most rotated by persons with brain damage, etc.[24]

Now it must be admitted that no one really knows the complete reason why it is that a person with organic brain damage should rotate a given figure more than a person with a psychosis. Nor do we know why a person with a neurosis would tend to rotate a figure more than a normal person. We can only posit an explanation.

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[24]Ibid., p. 8.

Goldstein and Scheerer indicate that brain damage makes a person a "passive subject instead of an active master."[25] Thus he is unable to actively master the enigma of the ambiguous figure-ground problem presented to him and falls victim to its ambiguity. His damaged brain is unable to correct for the ambiguity; then in turn he tends to reproduce his perceived distortions. These distortions are rotations on the M.P.D. test.

Persons suffering severe emotional or personality disturbances tend to produce rotations for a different, but somewhat allied reason. Research indicates that emotions are more aroused and general excitement greater in neurotics than in normals. Perception is affected because the high emotional and/or excitement level tends to reduce cue utilization. Distortion is also greater among the mentally confused and the greater the emotional stress, the greater is the perceptual distortion.

Normal persons tend to have stable perceptions. "The better centered and integrated a personality is, the more definite and stable are the perceptions."[26]

"Subjects who are neurotic or psychotic perceive the ambiguous stimuli on the M.P.D. test in terms of rotations greater than as perceived by normals but less than organics. A person under severe stress will misperceive similar to organics; however, in most testing situations the psychotic, neurotic, or

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[25]K. Goldstein and M. Scheerer, "Abstract and Concrete Behavior. An Experimental Study with Special Tests," Psychological Monograph, LIII(1941), pp. 32-57.

[26]K. Goldstein, The Organism, A Holistic Approach To Biology Derived From Pathological Data in Man (New York: American Book Co., 1939). p. 377.

sociopath will not be under severe stress unless he has lost control. On the whole, he will be in the middle of the continuum ranging from excitement to calmness."[27]

Having firmly established the rationale behind the M.P.D. and determined which of the Wertheimer designs tended to produce the rotational effects desired, Fuller and Laird set out in earnest to develop their test by means of five carefully planned steps. Each of these five steps was in essence a separate study, designed to empirically establish various aspects of the test.

Study 1. The five Wertheimer figures (A, 1, 2, 3, 8) which tended to rotate most were reproduced on six different types of frames so that there was a total of 30 cards. "Each set varied the orientation of figure and ground, so that some grounds were rectangular, some diamond shaped, and some figures were horizontal and others were vertical."

The 30 cards containing six sets of five configurations each were administered to 270 normal, emotionally disturbed, and schizophrenic children ranging in age from 8 to 15. Based on factorial analysis three sets and two configurations were found to differentiate the three groups at the .01 level of significance. This indicated definitely that certain combinations of figure-ground orientations and configurations produced more rotation than others. These two configurations set in their respective figure-ground orientations then became the nucleus of the M.P.D. test.[28]

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[27]Gerald B. Fuller and James T. Laird, "The Minnesota Percepto-Diagnostic Test," Journal of Clinical Psychology, Monograph Supplement, Vol. XIX, No. 16 (January, 1963), p. 9.

[28]Ibid., p. 4.

Study 2. At this point, study 1 was cross-validated. The three sets and two configurations were administered to 57 emotionally disturbed and 44 schizophrenic children again ranging in age from 8 to 15. No organics or defectives were tested. The M.P.D. was able to discriminate between the two groups at the .001 level of confidence in terms of mean degrees of rotation.[29]

Study 3. This study was eventually published in a more complex form than the draft which is cited in the test manual. However, both forms indicated that poor readers tend to rotate significantly more than good readers on the M.P.D. When published in Psychology in the Schools, this study also contained data on various subcategories of poor readers.[30]

Study 4. After additional experimentation and empirical evidence gathered as a result of this research, it was determined that the M.P.D. could discriminate between the following three groups of children classified on the basis of reading disability in terms of the number of degrees rotated:

a. Normal readers (1.86° mean rotation).

b. Secondary readers (11.05° mean rotation).

c. Organic readers (23.77° mean rotation).

The differences between these 3 groups were significant at the .01 level or .001 level. The difference in degrees of mean rotations between normal readers (1.86°) and primary readers (3.75°) were not significant. To over-

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[29]Ibid., p. 11.

[30]Gerald B. Fuller, "Perceptual Considerations in Children With A Reading Disability," Psychology in the Schools, Vol. I (1964), pp. 314-317.

simplify, primary readers were children with slight reading disabilities while secondary readers had serious reading disabilities. The categories were determined on the basis of clinical diagnosis.[31]

Study 5. Two hundred eighty-six male and female subjects were placed into the following three categories on the basis of known diagnosis:

a. Organics - 52 persons with chronic brain damage syndrome.

b. Personality Disturbance - 104 persons who were classed as seriously neurotic, characterological, or psychotic.

c. Normals - 130 persons never referred for emotional disturbance.

All persons selected for the study had normal intelligence as determined by the Full Range Picture Vocabulary test. Each subject was administered the M.P.D. after which it was scored in the normal manner. The differences in mean degrees of rotations between the groups were determined and then subjected to the "t" test.

The results indicated that the M.P.D. test differentiates between the organic, the personality disturbance, and the normal to a significant degree in a hospital population. By use of the M.P.D. test, the investigators were able to identify 90 percent of the normals, 80 percent of those with a functional personality disturbance, and 82 percent of the organics. These figures seem to indicate the M.P.D. discriminates between these groups as well as or better than other instruments of its type.[32]

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[31] Gerald B. Fuller and James T. Laird, "The Minnesota Percepto-Diagnostic Test," Journal of Clinical Psychology, Monograph Supplement, Vol. XIX, No. 16 (January, 1963), p. 13.

[32] Ibid.

Upon the completion of the five studies mentioned above, the M.P.D. test underwent the process of standardization. The scores obtained by 1249 individuals (540 adults and 754 children) who were administered the test formed the basis for this standardization.

The results obtained from the standardization samples were carefully analyzed to determine those cutoff points which would enable the test user to determine most accurately to which group an examinee properly belonged. To a large extent this consisted of determining what percentage of a given group would be correctly identified if the cutoff point for normals would be 15° of if it were 20°, and so on.

For the purpose of standardization, normals were defined as persons with no history of mental disorder or brain damage who were successfully functioning in the community. Persons were determined to be in other categories such as personality disturbance, schizophrenic, and brain damaged on basis of hospital diagnosis.

Based on the standardization studies, three sets of criteria were established to enable the examiner to interpret individual test results with a reasonable degree of assurance.

1. Children with Emotional Problems. If a child (aged 8 to 15, with an I.Q. of 80 to 110) has been referred because he is a behavior problem, the M.P.D. manual classifies him as follows on the basis of his score:

   a. Normal - score of 20 or less.

   b. Emotional Disturbance - score of 21 to 54.

   c. Schizophrenic - score of 55 or over.

2. Children with a Reading Problem. Children referred primarily because of a reading or learning problem rather than a behavioral problem are classified as:

a. Primary Reading Retardation - Scores of 25 or less.

b. Secondary Reading Retardation - Scores of 26 to 54.

c. Organic Reading Retardation - Scores of 55 or more.

The same age and I.Q. requirements mentioned in category 1 also apply here.

3. Adults. Best results are obtained with adults aged 18 to 65, with an I.Q. range from 80 to 110.

a. Normal Perception - Scores of 20 and below.

b. Personality Disturbance Perception - Scores between 21 and 59.

c. Organic Perception - Scores of 60 and above.

Scores obtained by subjects who do not fall within the I.Q. and age ranges indicated must be interpreted with extreme caution. Also based upon their standardization sample, the authors posited that age, I.Q., and education would have no significant effect on M.P.D. test results.[33]

It is necessary at this point however to indicate that the original norms established for the M.P.D. were based largely on experiments with older children and adults. They are not in fact applicable to children approximately ten years old and younger. In actual field use, the number of degrees rotation by normal children eight and nine years old would be much larger than that indicated in the manual.

[33] Ibid., pp. 15-19.

For this reason a new set of norms, due to be released this spring, are currently being prepared. Dr. Russell Ende, of Northern Illinois University, stated at the outset of the current study that the mean number of degrees rotations made by a third grade group would be about 50°. The accuracy of his prediction was brought out for when the mean of our sample was computed, it turned out to be 52°.

In view of this, it is essential that the current M.P.D. norms not be accepted as definitive, but rather as tentative. Such an adjustment in no way alters the rationale behind the test. It merely indicated that norms relative to each group must be used until field testing national standardization are complete.

Even with these guidelines to use in interpreting test results, the test user will find both false negatives and false positives, that is, persons who score higher or lower than their true diagnostic category would lead us to expect. Hence, it is essential to remember that the M.P.D. is not fool-proof. This does not detract from the excellence of the instrument since most tests of its type have even lower concurrent validity and in addition are more difficult to administer and score. But it does mean that caution must be used in interpreting the results.

POST-STANDARDIZATION RESEARCH ON THE M.P.D.

Since the appearance of the M.P.D. on the market, there have been several studies utilizing it in their investigations. Unfortunately the majority have been made by the test authors and their associates. It is always useful to have additional studies made by persons who are totally impartial, as an objective check on any far-reaching research such as that done on the P.M.A. This is not of course meant to imply conscious bias on the part of the author or his associates.

The most promising framework for the discussion of all post standardization research with the M.P.D. would appear to be the presentation of those articles written by Fuller first. This will then be followed by a presentation in roughly chronological order of those articles written by others. Through this mode of presentation we will get a clear look at Fuller's complete work first and then get to see what others have found in their research, particularly in so far as it corroborates or contradicts Fuller's findings.

In an in-depth follow up study (1965) which closely replicated several of his earlier studies Fuller demonstrated again the relationship between personality organization and stability of perception. Starting with the hypothesis that if perception is unstable and if there are no physiological defects present, one can suspect a personality disturbance, Fuller measured the perceptual stability of 860 persons. Of this total 450 were normals, 260 emotionally disturbed and 150 schizophrenics.

By using the M.P.D. test, he was able to differentiate between each group at the .001 level of significance. This seems to indicate that there was a significant difference between the three groups in so far as perceptual distortion was concerned!

This article also contains a good rationale and theoretical explanation of why the M.P.D. test works, and is the source of a statement in which Fuller says, "it has been our observation that I.Q.'s over 110 are related to rotation and that the higher the I.Q. the less rotation evidenced."[34] However, in a somewhat later study he did not find a positive correlation between I.Q. as indicated on the WISC and M.P.D. scores.[35] This leaves an unanswered question as to the actual relationship between intelligence and scores on the M.P.D. In the later study Fuller did find significant negative correlations with 87 subjects between M.P.D. test scores and 3 WISC subtests, namely: Information, Arithmetic, and Picture Completion. He concluded that "emotional disturbance does result in disturbance in perception," which contradicted Bender's (1938) claim that neurotic disturbances do not result in disturbance of perception.[36]

In another study by Fuller he found that the M.P.D. discriminated between children previously diagnosed clinically as having organic reading problems and a group of children having varying types of reading ability and/or disability.[37] This is the study which appears to be a more complex version of the third study cited by Fuller in his standardization of the M.P.D. test. In it, 287 children ranging in age from 8 to 15 were tested. The group consisted

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[34]Gerald B. Fuller, "The Objective Measurement of Perception in Determining Personality Disorganization Among Children," Journal of Clinical Psychology, XXI(July, 1965) p. 305-7.

[35]Gerald Fuller, "A Comparison of Intelligence and Perception in Emotionally Disturbed Children," Journal of Clinical Psychology, (April, 1966), Vol. XXII, No. 2 pp. 193-195.

[36]Ibid., p. 195.

[37]Gerald Fuller, "Perceptual Considerations in Children with a Reading Disability", Psychology in the Schools, I(1964) p. 314-317.

of 100 good readers, 49 readers with primary disability, 63 children with secondary reading disability, and 75 organic readers.

There was a significant difference in the mean number of rotations produced by each group with one exception. The difference between the good readers and the primary readers was not significant. As in most of his articles Fuller also included an explanation of the rationale behind the test.

In addition to the studies done by Fuller either alone or in collaboration with others, several independent studies have been made on the use of the M.P.D. test. Uyeno found the M.P.D. to be an effective tool in differentiating psychotics from organics.[38] Leon Kreitman in his study, administered the test to 67 children referred for a psychological evaluation. 53 were diagnosed as "Emotional Disturbance" and 13 as "Organic Dysfunction" on the basis of test results, school behavior, social histories, and medical findings. Kreitman found that the M.P.D. was able to identify correctly all 14 persons suffering from organic dysfunction and 77% of those suffering from emotional disturbance.[39]

At a symposium held at the 1965 annual meeting of the American Psychological Association in Chicago and chaired by Fuller, several other studies were

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[38]Ensley Uyeno, "Differentiating Psychotics from Organics on the Minnesota Percepto-Diagnostic Test," Journal of Consulting Psychology, XXVII (October, 1963), p. 462.

[39]Leon Kreitman, "A Note on the Use of the Minnesota Percepto-Diagnostic Test," Journal of Clinical Psychology, XXII, 2(April, 1966), p. 196.

presented. Stanley Krippner found that an M.P.D. diagnosis made on a selected sample of 24 persons with reading disabilities agreed with clinicians diagnoses in all but 2 cases.[40]

Luciano L'Abate reported a study in which she compared the results of the M.P.D. with the Revised Hidden-Figures and the Benton Revised Visual Retention tests. The performance on the M.P.D. of 2 samples of children with various diagnostic problems was compared with their performance on the other two tests. In most instances the M.P.D. discriminated between various groups more often and at a higher statistical level than the other two tests.[41]

A particularly ambitious study was reported by Gilbert Gredler who sought to test the worth of the M.P.D. in diagnosing the problems of culturally disadvantaged students. Unfortunately his sample was small and his theoretical framework wobbly so he was unable to draw significant conclusions.[42]

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[40] Stanley Krippner, Diagnostic and Remedial Use of the Minnesota Percepto-Diagnostic Test in a Reading Clinic, A study read at the symposium on "The Clinical Application and Remedial Use of a Perceptual Test in the Identification and Treatment of Learning Disorders in School Children," at the Annual Meeting of the American Psychological Association in Chicago, 1965.

[41] Luciano L'Abate, The Clinical Usefulness of the Minnesota Percepto-Diagnostic (M.P.D.) Test in the Laboratory Psychodiagnosis of Children, Journal of Clinical Psychology, Vol. XXII, No. 3(July, 1966), pp. 298-299.

[42] Gilbert Gredler, Performance of the M.P.D. Test: Educational and Diagnostic Validity for Children from Culturally Disadvantaged Areas, A report presented at the symposium on "The Clinical Application and Remedial Use of Perceptual Test in the Identification and Treatment of Learning Disorders in School Children", at the Annual Meeting of the American Psychological Association in Chicago, 1965.

Burnett and Fuller found a value for the test in discovering which groups of E.M.H. students could best profit from reading instruction and which needed more remedial work in the field of instruction. Results of this test indicated the need for further study to determine the interplay of intelligence and perception among E.M.H. students.[43]

The last study presented at the symposium was by Russell Ende of Northern Illinois University. Using a sample population of 1811 students in 14 Northern Illinois cities, he compared the ability of teachers to spot emotionally disturbed children with the results obtained on the M.P.D. test. The results indicate a significant lack of ability by the teachers to properly identify the least and most stable students in the classrooms. His conclusion is that the M.P.D. test should be considered a useful instrument for the identification of emotionally disturbed children in the classroom situation.[44]

Since the time of the symposium two additional studies dealing with the M.P.D. have been published in the Journal of Clinical Psychology. The first study was an attempt to determine the clinical validity of the M.P.D. test with

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[43]Alastair Burnett and Gerald B. Fuller, Minnesota Percepto-Diagnostic Test Performance in Educable Mentally Retarded Children: Standardization, Normative Data, Comparison With Other Diagnostic Groups and Detection of Organic Brain Damage, A report presdnted at the symposium on "The Clinical Application and Remedial Disorders in School Children," at the Annual Meeting of the American Psychological Association in Chicago, 1965.

[44]Russell S. Ende, An Application of a Perceptual Test to School, A Report Presented at the Symposium on the Clinical Application and Remedial Use of a Perceptual Test in the Identification and Treatment of Learning Disorders in School Children, at the Annual Meeting of the American Psychological Association in Chicago, 1965.

adults in India. As often happens in the case of a test standardized in one cultural milieu, the test was found to have doubtful validity in India.[45]

When the M.P.D. was administered to an adult clinical population in India, it failed to differentiate organics from personality disturbance and normal groups.

A second study, conducted in Canada, also indicated that the M.P.D. test is not "culture free". It did however, seem to bear out the fact that sex and intelligence (within the limits of the study) have no significant influence on the production of degrees of rotation on the M.P.D. test.

The results further supported the viewpoint that the evolution of Gestalten and their reproduction is due to maturational rather than educational or imitative processes.[46]

Finally, Uyeno collaborated with Fuller in an investigation of perception among psychotics. A male hospitalized psychotic population was divided into two carefully matched groups designated as good perceivers (N=39) and poor perceivers (N=39). Comparison between the two groups after administration of the M.P.D. and M.M.P.I. yielded the following findings:

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[45] Satinder K. Paul, "The Clinical Validity of the Minnesota Percepto-Diagnostic Test with Adults in India," Journal of Clinical Psychology, Vol. XXII, No. 3(July, 1966), pp. 299-301.

[46] Donna M. Harrison and J. Gilles Chagnon, "The Effect of Age, Sex, and Language on the Minnesota Percepto-Diagnostic Test", Journal of Clinical Psychology, Vol. XXII, No. 3(July, 1966), pp. 302-303.

1. The good perceiver group was brighter and younger than the poor perceiver group.

2. The good perceiver group consisted mainly of paranoid and acute schizophrenics while the poor perceiver group was composed mainly of the chronic, undifferentiated type.

3. Both groups differed significantly on M.P.D. and M.M.P.I. scores.[47]

The review of the literature on the M.P.D. test and related instruments yielded a great deal of data on the M.P.D. and provided a setting for current research. But many important questions regarding the M.P.D. remained unanswered. In order to answer these questions additional research was needed. The best way to conduct such research appeared to be through the use of reliable and valid tests which measured reasonably "pure" perceptual and/or intellectual factors. A short description of each test ultimately selected for this study, together with a resume of the available research data pertaining to its factorial pureness, is contained in the following section.

FACTORIAL PURENESS OF LORGE-THORNDIKE

The Lorge-Thorndike I.Q. test yields three scores; a verbal I.Q., a non verbal I.Q., and a total I.Q. The correlations between the verbal and non verbal scores for the eight test levels range from about .65 to .75. While these intercorrelations are high enough to indicate that similar functions are being

[47]Gerald B. Fuller and Ensley Uyeno, "Perception as a Function of Severity of Disturbances in Psychotics," Perceptual and Motor Skills, Vol. XX, No. 3 part 1(1965), pp. 953-958.

measured in the two test sections, they are enough lower than the reliabilities to indicate that the differences do have some stability and significance.

Correlations of the verbal and non verbal batteries were based on a sample of 4500 students from grades 4 to 12 (about 500 at each grade level). Intercorrelations between the 8 subtests ranged from .404 to .750 for 250 sixth graders.[48]

This sample was part of a representative group of sixth grade pupils taken from the standardization population. The intercorrelations obtained between the subtests for this group were subjected to a centroid factor analysis. Four factors were extracted, of which the fourth appears trivial and meaningless. The results were as follows: (See Table 2)

In the centroid analysis more than 85% of the variance accounted for by the four factors is represented in the first factor. This seems to indicate quite strongly that what is being measured by the eight subtests of both the verbal and non verbal Lorge-Thorndike is a general factor of cognitive ability. This fact was borne out further when a graphic orthogonal rotation was carried out on the first three factors. A slight differentiation between the verbal and non verbal test is represented in the second factor. The third factor distinguished the two number tests from the remainder.[49]

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[48]Irving Lorge, Robert L. Thorndike, and Elizabeth Hagen, Lorge-Thorndike Intelligence Tests Technical Manual, Multi-Level Edition, (Boston: Houghton Mifflin Company, 1966). p. 15.

Table 2

Factor Loadings of Part-Scores Based on
250 Sixth Grade Pupils

	Centroid Loadings				Rotated Loadings				
Part Score	I	II	III	IV	I	II	III	IV	h^2
1.Vocabulary	.84	.18	.14	.09	.76	.37	.05	.09	.76
2.Sentence Completion	.74	.26	.13	.14	.65	.44	.05	.14	.65
3.Arithmetic Reasoning	.60	.13	-.35	-.11	.49	.28	-.42	-.11	.51
4.Verbal Classification	.80	.18	.08	-.12	.68	.37	-.07	-.12	.68
5.Verbal Analogies	.77	-.12	.10	-.28	.75	.07	-.08	-.28	.70
6.Figure Classification	.72	-.13	.10	.18	.70	.05	-.07	.18	.57
7.Number Series	.76	-.22	-.18	.12	.65	-.03	-.26	.12	.67
8.Figure-Analogies	.82	-.28	-.02	-.02	.84	-.06	-.11	-.02	.75
Variance Accounted For	4.59	.31	.22	.18					5.30

The authors of the Lorge-Thorndike technical manual feel that the first factor corresponds well to Spearman's "eduction of relations and correlates." The Lorge-Thorndike is not popular as far as research is concerned and has only recently had these results published in the technical manual(1966). As a result, there have been no known studies published to either prove or repudiate this belief. In view of the general excellence of this test and its statistical framework, however, a great deal of credence must be attached to this claim.

The high factor loading of Spearman's "g" possessed by the Lorge-Thorndike thus gives it two functions in our study. First, it serves as an excellent classificatory device for use in selecting a stratified sample. Secondly, it gives a good measure of general intellectual ability with which to compare our M.P.D. results.

S.R.A. PRIMARY MENTAL ABILITIES

In 1938, the grandfather of the current PMA test first came on the scene as an experimental edition called the Tests for Primary Mental Abilities. It originally provided measures of seven factors and required 222 minutes to administer. These early forms were based on extensive research by Thurstone and his students and represented an important breakthrough in test construction. On the basis of factor analysis, Thurstone proposed a series of group factors in human intelligence which he designated, "Primary Mental Abilities."

As he saw it, intelligence was made up of a number of more or less separate factors, capable of being determined by statistical analysis. The seven "Primary Mental Abilities" he considered most important were included in his test.

Unfortunately Thurstone was content to let his test stand on his initial theoretical constructs and never proved his position empirically. Over the years, the test was revised several times, but it was only made shorter. Until recently no serious attempt was made to even report accurately the reliability and validity of the test, much less improve it.

The reason for the frank appraisal of a test included in this study is to make clear the fact that the author has no false illusions regarding the excellence of this test. It isn't an excellent test, but it is a good test. The theoretical framework still remains sound, the items are well written, and test construction is above average.[50]

Moreover, in the late fifties the publishers, perhaps under the goad of slipping business, started a series of revisions which at least brought clear statements on reliability, validity, and usability in improved manuals at all levels.

These facts coupled with the knowledge that the PMA tests are the only Multi-Aptitude Test used extensively at the primary level led to their adoption for this study. In addition usage itself has provided some insights into the worth of the PMA.

The current form of the PMA test used in this study is the PMA for grades 2 - 4, revised in 1962. Four subtest areas are measured by this edition: verbal meaning, spatial relations, number facility, and perceptual speed. A total score is also obtained, based on the subtest scores. I.Q. scores are reported both in the traditional method $\left(\frac{MA}{CA}\right)$ and as deviation I.Q.'s.

The 1962 revision of the PMA represents a rather drastic change from earlier editions of this test and as a result, studies of the PMA made prior to 1962 would reflect only indirectly upon the factorial make up of the current

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[50] Norman Frederiksen, "SRA Primary Mental Abilities," The Fifth Mental Measurements Yearbook, ed. Oscar Buros, (Highland Park, New Jersey: The Gryphon Press, 1959) pp. 709-714.

Ibid., Albert K. Kurtz, pp. 714-717.

test. For this reason, the number of studies which deal with the factorial structure of the 1962 revision are small in number.

From a logical point of view the four subtests of the PMA appear to measure quite separate factors. The items contained in the four subtests are quite disparate from each other and are of such a nature that they would logically be expected to measure what they purport to measure. Milholland tells us that three judges passed on the appropriateness of each item.[51] In addition, the spatial visualization test is similar to test S-1 in ETS Kit of Reference Tests for Cognitive Factors, while the Perceptual Speed Test is similar to test P-3 in the same Kit. In fact both test S-1 and P-3 were taken from L. L. Thurstone's work.[52]

The technical manual for the current PMA however contains no factor analysis data. The only data it contains applicable to this area are some tables showing the intercorrelations of subtest score and the total test score on the PMA batteries K-12. Since we are most concerned with the third grade data and since the third grade data presented is similar to that found for the remaining grade levels, it is included in table 3.[53]

Even more pertinent to the current study are the intercorrelations found with a sample of 150 students from District #4, Addison, Illinois.

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[51]John E. Milholland, "Lorge-Thorndike Intelligence Tests," The Fifth Mental Measurements Yearbook, ed. Oscar Buros, (Highland Park, New Jersey: The Gryphon Press, 1959) p. 482.

[52]John W. French, Ruth B. Edstrom, and Leighton A. Price, Manual For Kit of Reference Tests for Cognitive Factors(Princeton, New Jersey: Educational Testing Service, 1963). pp. 32 and 40.

[53]Primary Mental Abilities Technical Report(Chicago: Science Research Associates, Inc., 1965). pp. 16-17.

Table 3

N 73 (School B)

	V	S	N	P	TOTAL
V		.54	.68	.55	.83
S	.54		.52	.35	.67
N	.68	.52		.53	.89
P	.55	.35	.53		.76
T	.83	.67	.89	.76	

Table 4

District 4

N 150

	V	S	N	P	TOTAL
V		.331	.374	.346	
S			.377	.327	
N				.369	
P					
T	.666	.617	.837	.686	

While the results taken from the PMA technical manual did not give strong evidence that the PMA subtests measure separate factors, more promising results were obtained from the sample used in this study. The intercorrelations found between the subtest scores ranging from .327 to .377, are noted in Table 4 above.

The scores made by the sample on the 4 subtests of the PMA were also subjected to several factor analyses to obtain a clear picture of the factors measured by these subtests.

The principal components technique of factor analysis was used to determine the simple factorial structure of the PMA test. The first analysis was run with just the 4 PMA subtest scores included in the factor matrix and a factor matrix including the 4 unrotated factors was obtained. This matrix is reproduced in table 5.

Table 5

FACTOR MATRIX

4 UNROTATED FACTORS

Factor Number			1	2	3	4
Sum of Squares			2.072	0.675	0.651	0.602
Percent 4 Factors			51.8	68.7	84.9	100.0
4 Factors			51.8	68.7	84.9	100.0
No.	Name	Communality				
1	Verbal	1.000	0.714	-0.292	-0.598	0.217
2	Spatial	1.000	0.706	0.635	0.084	0.301
3	Numercial	1.000	0.748	0.081	-0.016	-0.658
4	Perceptual Speed	1.000	0.709	-0.423	0.535	0.176

As is normal the analysis performed without rotating the vectors yielded inconclusive results.

All 4 factors were then rotated to present a different picture of the factorial structure of the PMA test. However, the program utilized was able to derive just 2 factors accounting for a total of only 68.7% of the total variance. This left so much variance unaccounted for that several new approaches were tried to factor analyze the PMA test. First, various test and subtest scores from the remaining 12 variables were added to the PMA subtest scores and a factor analysis performed on the resulting combinations. Then finally a factor analysis was performed on the scores from all 16 variables. From 2 to 6 factors were factored out in most cases. It must be emphasized at this point that factor analysis is a statistical technique in which a desired number of factors can be obtained through manipulation of the data and computer program. In short, the deck can be stacked to prove almost any theory. Thus, the extra factor analyses of the PMA test were performed to provide an unbiased picture of the PMA's factorial structure. The clearest factor analysis is included in table 6. It illustrates the factorial structure of a group of 9 tests, 4 of which are PMA subtests. Three PMA factors appear to be clearly identified. Factor 1 appears to be a general intelligence factor; factor 2 a speed perception factor; and factor 3 a spatial visualization factor. The Verbal subtest of the PMA appears to measure all 3 factors.

These findings were borne out by similar results in the other analyses. It would appear therefore that the 4 PMA subtests measure a total of 3 factors:

1. The Numerical subtest measures a numerical ability factor composed of intelligence and a form of spatioal relations(Frostig test).
2. The Perceptual Speed subtest measures a separate perceptual speed factor.

Table 6

FACTOR MATRIX

6 ROTATED FACTORS

Factor Number (Before Rotation)		1	5	3	6	2	4
Sum of Squares		2.214	1.204	1.167	1.104	1.023	1.007
Percent 9 Factors		24.6	38.0	50.9	63.2	74.6	85.8
6 Factors		28.7	44.3	59.4	73.7	87.0	100.0
No. Name	Comm.						
1 Lorge-Thorndike Verbal	.869	.913	-.159	.068	-.030	.000	.074
2 Lorge-Thorndike Non-Ver.	.801	.847	-.067	.146	-.218	.067	.073
3 M.P.D.	.997	.104	-.121	.025	-.122	.082	.974
4 Frostig Posn. in Space	.979	.072	-.107	-.003	-.113	.971	.080
5 Frostig Spat. Rel.	.869	.185	-.087	.899	-.137	-.024	.022
6 PMA Verbal	.727	.428	-.542	-.223	-.441	-.048	.058
7 PMA Spatial	.924	.179	-.098	.224	-.889	.151	.138
8 PMA Numerical	.671	.612	-.248	.436	-.147	.147	.040
9 PMA Percept. Speed	.883	.152	-.881	.208	-.052	.147	.127

Number of Rotations for Varimax Convergence 9

3. The Spatial Relations subtest measures a separate spatial relations factor.

4. The Verbal subtest measures a type of general ability composed of intelligence, perceptual speed, and spatial relations. This subtest appears to measure nothing not now measured by one of the other 3 subtests.

This information would have been most useful at the start of the current study, but it is doubtful whether such knowledge would have affected the research design.

PROGRESSIVE MATRICES AS A MEASURE OF THE "g" FACTOR

The "Progressive Matrices was constructed on the assumption that if Spearman's principles of neogenesis were correct, it should provide a test suitable for comparing people with respect to their immediate capacities for observation and clear thinking."[55] "By itself it is not a test of 'general intelligence', but has been found to have a 'g' saturation of 0.82."[56]

The Progressive Matrices which will be discussed in greater detail in Chapter three is thus described by its author, J. C. Raven, as a reasonably pure measure of Spearman's "g" factor. The fact that this test is heavily loaded with a factor common to most intelligence tests (call it "g", "x", "q", or what ever you want) has been clearly indicated by several factorial

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[55]J. C. Raven, Guide to the Standard Progressive Matrices(London: H. K. Lewis and Co. Ltd., 1960). p.1.

[56]Ibid., p. 2.

analyses. These same factorial analyses have also proven that additional group factors such as spatial aptitude and perceptual accuracy also influence performance.[57]

The actual extent to which the PM has been found to be loaded with the "g" factor as well as the extent to which other factors have influenced performance on the PM by various investigators seems contingent on these three factors:

1. The nature of the sample used in the study.
2. The techniques employed by the experimenter.
3. The bias of the experimenter.

As a result we have Vernon and Parry referring to the PM as "an almost pure 'g' test"[58] while Adkins and Lyerly found no evidence for a general reasoning factor nor any factor suggesting the presence of Spearman's "g" among their first order factors.[59]

The best source of additional information in this area is to be found in Burke's review and evaluation of studies done on the PM up to the year 1958.[60]

57Anne Anastasi, Psychological Testing (2nd. ed.; New York: The MacMillan Co., 1961).

58P. E. Vernon and J. B. Parry, Personnel Selection in the British Forces (London: Univ. London Press, 1949).

59D. Adkins and S. B. Lyerly, Factor Analysis of Reasoning Tests(Chapel Hill, N. C.: Univ. North Carolina Press, 1952).

60H. R. Burke, "Raven's Progressive Matrices: a Review and Critical Evaluation," Journal of Genetics Psychology, Vol. XCIII(September, 1958), pp. 199-228.

The Sixth Mental Measurements Yearbook contains references to the vast majority of studies done on this test since that date in addition to an excellent review of the test itself.[61]

Whatever one's personal feelings are on the number and arrangement of factors making up human intelligence, the fact remains that there are several ways in which to view intelligence. Each has its faults, and each has its virtues. Whether one wishes to ascribe success in a large variety of situations to a general factor or a series of specific ones is too often a matter of petty quibbling. Sufficeth to say that experimentation seems to indicate that the PM has a strong factor loading of "g" and for this reason is included in this study.[62] Should the reader seek for his peace of mind to consider "g" as being made up of other more specific factors, he may.

In addition to its rather high loading in "g" the PM has also been found to be of value in discerning brain damage. Evans and Marmorstan found that by use of Raven's Coloured Progressive Matrices they were able to discriminate brain damaged patients from non brain damaged patients at a significant level. They also found the raw score to be as useful as any of the more elaborate scoring schemes used to detect brain damage.[63]

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[61]Morton Bortner, "Progressive Matrices," The Sixth Mental Measurements Yearbook, ed. Oscar Buros, (Highland Park, New Jersey: The Gryphon Press, 1965) pp. 489-491

[62]H. R. Burke, "Raven's Progressive Matrices: A Review and Critical Evaluation," Journal of Genetics Psychology, Vol. XCIII(September, 1958), pp. 199-228.

[63]Raymond B. Evans and Jessie Marmorston, "Scoring Raven's Coloured Progressive Matrices to Differentiate Brain Damage," Journal of Clinical Psychology, Vol. XIX(July, 1964), pp. 360-364.

Bradley in another recent study used the PM in a study which seemed to indicate that brain injured children are not a homogeneous group and that there are different patterns of perceptual disabilities to be found in that group of children lumped into the brain damaged category.[64]

FROSTIG TEST AND PERCEPTUAL FACTORS

The Marianne Frostig Developmental Test of Visual Perception is of recent origin. A pilot study, using the preliminary Frostig test, was conducted in 1959. It was followed by a second version of the test in 1960. For this study we used the "Third Edition," published in March 1961 and standardized in 1963.

The rationale underlying this test is that there are five important areas of visual perception and that development in these areas takes place at varying rates for different children. There are two sub ideas implicit in this concept. First, no two children develop at the same rate or with the same patterns of development. Second, the development in these areas will not be regular or smooth even within the same child. Thus, a child may excel in one area, do moderately well in three others, and be completely incompetent in the fifth area.

But it is very important to point out that the subtests on the Frostig test are relatively short, which greatly reduces the reliability of each subtest. As a result there always exists the very distinct possibility that the

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[64] Betty Hunt Bradley, "Differential Responses in Perceptual Ability Among Mentally Retarded Brain Injured," Journal of Educational Research, Vol. LVII, No. 8(April, 1964), p. 421.

low intercorrelations between the subtests may be due in part to the decreased reliability of each subtest.

The test was developed on the postulate, based on the experience of Dr. Frostig and the findings of others, "that each of the five abilities developed relatively independently of the others, and that there should be specific relationships between them and a child's ability to learn and adjust."[65] These five visual perceptual abilities were not proposed as the only abilities involved in the total process of visual perception, but they were conceived to be important parts of the process and seemed to have particular relevance to school performance.

The test which Dr. Frostig developed was a series of carefully chosen test items to measure the five areas of visual perception she posited as factors independent of each other. What she sought to do in the words of Anderson, was, "to build a test of low band width (complexity of information) and high fidelity (exactness of information). In this she seems to have succeeded."[66]

If these five areas are in fact separate from each other and if the test accurately measures these factors, we would then expect the intercorrelations between the five subtests within the Frostig test to be rather low. That this

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[65]Marianne Frostig, Phyllis Maslow, D. Welty Lefever, John R. B. Whittlesey, The Marianne Frostig Developmental Test of Visual Perception, 1963 Standardization (Palo Alto, California: Consulting Psychologists' Press, 1964). p. 464.

[66]James M. Anderson, "Marianne Frostig Developmental Test of Visual Perception, Third Edition," The Sixth Mental Measurements Yearbook, ed. Oscar Buros, (Highland Park, New Jersey: The Gryphon Press, 1965) pp. 854-857.

in fact is the case is borne out by figures obtained on the standardization sample. At the kindergarten product-moment correlations of subtest scores ranged from .16 to .48; at the first grade level, from .26 to .41; at the second grade level, from .21 to .37; and at the third grade level, from .01 to .32.[67]

These figures are most remarkable especially when one considers that the types of items used on this test are often lumped into one category on other tests and called "perceptual ability" without an attempt at differentiation. That this test does discriminate among the areas, has also been proven empirically by the author through his own experience and the experience of other trained examiners. It's somewhat amazing to administer the test to a child and see him score at his age level in 4 areas and 3 years below his age level in the fifth area.

Since the tests's publication several pertinent studies have been conducted. In general they have been of two types. Several investigators used the test to determine the nature and pattern of scores obtained by special groups such as brain damaged children or poor readers.

Frostig for example found a correlation between disabilities in visual perception and poor classroom adjustments at the kindergarten and first grade level and to some extent at the second grade level. After a child is about

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[67]Ibid., p. 487.

$7\frac{1}{2}$ years old, cognitive values begin to take dominance and aid faulty perception in most children.[68]

Corah and Powell on the other hand undertook a factor analysis study of the Frostig test. They found that two factors, intelligence and developmental changes in perception would account for a high percentage of variance on the five subtests of the Frostig test, and that four factors would account for 70% of the total variance. Unfortunately they drew all these assumptions with a sample N of only 40 and based their conclusions on testing instruments which themselves need further standardization and study.[69]

In addition to correlational and analytical studies, several other articles of the, "Gee, look what we're doing and ain't it nice!" type, dealing with the use and benefits of the Frostig Test and the Frostig Remedial Program have appeared. To explore these however, would be of no real value at this time.

"The test seeks to measure five operationally - defined perceptual skills, as follows:

TEST I

<u>EYE-MOTOR COORDINATION</u> - a test of eye-hand coordination involving the drawing of continuous straight, curved, or angled lines between boundaries of various width, or from point to point without guide lines.

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[68] Marianne Frostig, "Visual Perception in the Brain Damaged Child," <u>American Journal of Orthopsychiatry</u>, Vol. XXXII(March 1962) pp. 279-280.

[69] Norman L. Corah and Barbara J. Powell, "A Factor Analytic Study of the Frostig Developmental Test of Visual Perception," <u>Perceptual and Motor Skills</u>, Vol. XVI(February 1965), pp. 59-63.

TEST II

FIGURE GROUND - a test involving shifts in perception of figures against increasingly complex grounds. Intersecting and "hidden" geometric forms are used.

TEST III

CONSTANCY OF SHAPE - a test involving the recognition of certain geometric figures presented in a variety of sizes, shadings, textures, and positions in space, and their descrimination from similar geometric figures. Circles, squares, rectangles, ellipses, and parallelograms are used.

TEST IV

POSITION IN SPACE - a test involving the discrimination of reversals and rotations of figures presented in series. Schematic drawings representing common objects are used.

TEST V

SPATIAL RELATIONSHIPS - a test involving the analysis of simple forms and patterns. These consist of lines of various lengths and angles which the child is required to copy, using dots as guide points."[70]

Scores are computed for each of the subtests individually and for the test as a whole. Thus, a total of 6 scores are available for each person tested. The five subtest scores are expressed in one or more of three ways: raw score, perceptual age equivalent, and scaled scores. A total perceptual

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[70] Marianne Frostig, Welty Lefever, and John R. B. Whittlesey, Administration and Scoring Manual for the Marianne Frostig Developmental Test of Visual Perception(Palo Alto, California: Consulting Psychologists Press, 1964). p. 5.

quotient can be derived for the test as a whole. Raw scores will be used to determine correlations for the purposes of this study inasmuch as they provide a wider range than scaled scores.

LIMITATIONS OF STUDIES ON M.P.D. TO DATE

Whatever the limitations of studies made on the M.P.D. to date, the chief limitation would appear to be this. There have not yet been enough studies made. The majority of the studies made thus far have employed good sampling techniques and excellent experimental designs. And those studies dealing with concurrent validity have employed outstanding criteria. However, when the total knowledge gained from all these studies is summed up there still remain many gaps in our knowledge of the M.P.D., what it measures, and how it works. It is precisely these gaps in knowledge which must be considered serious limitations of all studies on the M.P.D. to date. Among such limitations would be included the following:

1. The relationship between a score on the M.P.D. and intelligence (scholastic ability) has not been clearly established.
2. It has not been clearly established that the M.P.D. is measuring perceptual functions. If it is, the nature and number of the factors involved has not been established.
3. The relationship between a score on the M.P.D. and personality factors has not been established.
4. The value of the M.P.D. in predicting organic brain damage and/or personality disorders in an average pre-school or school population remains unproven.

5. The nature and number of psychomotor skills essential for success on the M.P.D. has not been explored.

6. The value of the M.P.D. as a screening device for detecting brain damage and personality disorders in an average adult population remains untested.

It is not the province of this study to fill all six major gaps in our knowledge of the M.P.D. Our intention is merely to help fill some of the smaller gaps and hopefully to make it easier for others to complete the total picture.

CHAPTER III

DESCRIPTION OF POPULATION

School District 4 in Addison, Illinois, DuPage County, was selected to furnish the sample for this study because of two important reasons. First of all, district officials were interested and willing to participate in the study. Second, Addison and its public school population possess unique statistical advantages seldom found in any community. These advantages revolve largely around the fact that Addison is about as average a community as can be found in Northern Illinois.

Originally a small farming community founded by German settlers in 1834, Addison was incorporated as a village in 1884. By 1955 its population was only 800 but then it began to grow in earnest until its current population is 20,000. In fact, the population increase during the fifties was 72%. Having a total area of slightly over 4 square miles, Addison is located 20 miles from downtown Chicago to which it is connected by the Eisenhower Expressway.

Median age of the population is approximately 20; median income, about $8,100. On a socio-economic scale ranging from a high of 1 to a low of 15, Addison is given a rating of 8 by Chicagoland's Community Guide.[1]

All major religious denominations and ethnic groups (with the exception of non-white racial groups) are well represented within the community, but no

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[1]Jack W. Kleeman(ed.) Chicagoland's Community Guide(Chicago, Ill.: The Law Publishing Co., 1965), p. 106.

group clearly predominates. There are two Catholic schools and a Lutheran school. Housing runs the range from one room apartments and small bungalows to hugh condominiums and $100,000 homes.

Business is represented by both small stores and large shopping centers. There is also a large industrial area in town in which both light and heavy industry are found. As might be expected, every segment of American industrial, business, and professional life is represented in Addison including farming. It is not an area made up largely of teachers, or factory workers, or engineers. In short, Addison is about as accurate a slice of modern American life as can be found, differing from most other communities only in their deep interest in education.

District 4 had 4,100 students and 164 certified personnel at the time of this study. There were 6 elementary schools (K-6) and 1 junior high school. The median I.Q. as measured by the Lorge-Thorndike I.Q. test in November, 1965, was 102.3 for the third grade, with a range of 67 to 140. The range on the 6th grade I.Q. test results ran from 67 to 145 with a median I.Q. of 104.8. Combining the 2 sets of results (a purely arbitrary technique) yielded a composite I.Q. of 103.5 with a range of 67 to 145. Based on past test results, this median I.Q. and range appear typical of the district as a whole.

Traditionally, median scores for the entire district on the Iowa Tests of Basic Skills in all areas have been slightly above (1 to 4 months) the national norms at all grade levels, with one exception. Median scores on the Mathematics Problems section of the test have been slightly (1 to 2 months) below national norms for some grade levels.

The third grade population from which the sample for this study was drawn had the following median scores on the Iowa Tests of Basic Skills, as measured during the first week of October, 1966:

Vocabulary	3.26	Maps	3.21
Reading	3.19	Graphs	3.15
Spelling	3.14	Reference	3.10
Capitalization	3.04	Total Work Study Skills	3.16
Punctuation	3.18	Math Concepts	3.13
Usage	3.25	Math Problems	3.20
Total Language	3.15	Math Total	3.17
		Composite	3.19

Their median I.Q. as measured by the Lorge-Thorndike I.Q. test was:

V - 103.7

N.V. - 104.6

Total - 104.4 with a range of 59 to 143 Total I.Q.

The third grade class was selected for this study due to the following reasons:

1. The intercorrelations between the five parts of the Frostig test were lowest at the third grade level indicating greater factorial purity. In addition the highest grade at which this test can be used effectively is third grade because by fourth grade perceptual maturity is generally completed.

2. The lowest grade level at which the regular Lorge-Thorndike I.Q. test can be used effectively is third grade. Below this level a primary type I.Q. test must be used.

3. The Lorge-Thorndike I.Q. test is normally given to third grade students in District 4 and the results were available for use in the study. This test had done an excellent job in the past of rating children on a continuum of intellectual ability and had yielded almost perfect bell shaped curves, an indication of good discrimination.

4. The M.P.D., PMA, and Progressive Matrices can all be used effectively at this level, yielding good reliability and validity coefficients.

5. Gross rotations on the M.P.D. are produced by normal pre-school children but should disappear by the time they are eight (third grade) as a function of maturation.[2]

6. It was essential to test the M.P.D. at as low a grade as possible to determine the feasibility of its use as a diagnostic and screening instrument for young children.

DETERMINATION OF SAMPLE

A random sample of 150 students to be used in the study was selected from the total third grade public school population in the following manner. All third grade students who took the Lorge-Thorndike I.Q. test and had not transferred out of the district were grouped by I.Q. scores into intervals covering 5 points of I.Q. and a frequency distribution set up. The average I.Q. score for the third grade population was taken as the midpoint of the middle interval in our frequency distribution and the other intervals grouped around it in the usual fashion. A 3 x 5 file card was then made up for each student on which

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[2]Information on appropriate level at which to use all tests derived from technical manuals of the tests concerned.

was written his or her name, I.Q. score, school, room number, and sex designation. The cards were then sorted out so that all the members of a given frequency interval were grouped together.

At this point, 150 was divided by 406, the total number of students eligible for the study, to determine the percentage (37%) to be chosen from each frequency interval. A table was then set up(see table 7) to aid in the selection of the sample.

The total number of persons in each interval was determined together with the number of boys and girls in that interval. Then the total figure was multiplied by the percentage(expressed as a decimal, .37) which expressed the ratio of the sample to the total population tested. The figure obtained was rounded off to the nearest whole number and it then represented the number of students to be chosen at random from each interval. At this point it was decided to choose an equal number of boys and girls from each interval whenever possible so as to obtain a sample of boys and girls with approximately equal intellectual ability. Where it was impossible to do so or where an odd number of persons was needed for an interval, the deficiency was made up at the next highest interval at which it was possible to do so.

The sample for each interval was chosen by dropping the cards of the students scoring at that interval in a box, mixing them up, and reaching in to draw out the cards. In those cases where a boy's card was drawn and the requisite number of boys' cards had already been drawn, the card was set aside and the drawing continued until the desired number of girls' cards drawn. The process was reversed in those cases where the required number of girls' cards was drawn first.

TABLE 7

NUMBER	FREQ. INTERVAL	TOTAL NUMBER IN INTERVAL	BOYS	GIRLS	TOTAL NUMBER OF SAMPLE	BOYS	GIRLS
1.	57 (& below)-61	1	1	0	1	1	0
2.	62-66	1	0	1	1	0	1
3.	67-71	0	0	0	0	0	0
4.	72-76	4	3	1	1	1	0
5.	77-81	14	11	3	5	3	2
6.	82-86	16	13	3	4	2	2
7.	87-91	40	26	14	16	8	8
8.	92-96	45	21	24	17	8	9
9.	97-101	55	40	15	20	11	9
10.	102-106	62	29	33	23	11	12
11.	107-111	39	20	19	14	7	7
12.	112-116	41	17	24	15	7	8
13.	117-121	41	12	29	15	7	8
14.	122-126	19	8	11	7	4	3
15.	127-131	17	10	7	6	3	3
16.	132-136	9	3	6	3	1	2
17.	137-141	1	0	1	1	0	1
18.	142-146	1	1	0	1	1	0
19.	147-151(& above)	0	0	0	0	0	0
		406			150	75	75

DISTRIBUTION OF THIRD GRADE STUDENTS IN DISTRICT 4 BASED ON I.Q. SCORES

COLLECTION AND PROCESSING OF DATA

A list of the students making up the sample was ~~then~~ drawn up and each person assigned a code number. From this master list was made a list of those students to be tested at each school together with their room numbers. The list of students to be tested was then sent to the principal of the school involved and final arrangements made for testing.

The schools were arranged in alphabetical order and testing was conducted at each in turn, ~~beginning with the Ardmore School.~~ On the date assigned for testing, the Frostig Test was administered to the sample group beginning at 9:00A.M. In most cases, testing with the Frostig was finished by 10:00A.M. and the children were allowed a 25 minute recess period. Then the PMA test was administered. This normally took the rest of the morning. The Frostig Test and the PMA test were administered either in a classroom or the school library. Both locations seemed to work equally well. ~~Manila folders were placed upright between the students when testing in the library in order to prevent copying.~~

In the afternoon the Progressive Matrices test was administered first to groups of 8 to 12 each. Then the M.P.D. was administered individually to each of the children after they had finished the PM and been given a recess break. Total testing time for the PM and the M.P.D. averaged about 40 minutes. Despite the somewhat heavy testing schedule the children showed no fatigue and in fact seemed to enjoy the test sessions. Perhaps due in part to the fact that they knew the tests were "special" and "not counted" on their report cards, they regarded the tests as largely fun. While no testing rules were broken, everything possible was done to make the day pleasurable and the children responded well.

The original schedule of testing took 7 school days. Students who missed one or more of the tests due to absence or illness were administered the remaining tests within a week after the initial tests were administered at his or her school.

In a few cases, due entirely to prolonged illness (a flu epidemic), the original person selected for the sample could not be economically tested without holding up the entire study. In those cases, an alternate was selected, with the same I.Q. and from the same school whenever possible. When this was impossible, a person of the same sex with the closest I.Q. was selected. In 2 or 3 cases, this meant going up or down an interval of I.Q. range.

All testing was done by the author with the aid of an assistant. The author has 10 years experience in the administration and scoring of group tests and 4 years of experience with individual tests. His assistant, an elementary school teacher with several years experience, was trained in the administration of the tests to be used in the study. In addition, both the author and his assistant administered several practice tests of each type prior to the start of this study.

After all the tests were collected, they were carefully corrected as per manual instructions and scored. The results were posted to a set of master sheets on which were recorded the code numbers of each student together with the scores obtained on each test. All steps in this process were checked twice by two additional persons trained in the area of testing.

At this point the data from the master score sheet was punched onto I.B.M. cards and phase one the study started. A printout was made and the data verified. An I.B.M. program for computing correlations was fed into an I.B.M. 1620 computer together with the data. Then a correlation matrix correlating all 16 scores indicated in Chapter I with each other was computed. In addition to the correlation matrix, the I.B.M. program also computed the mean, S.E. of the mean, and standard deviation of all 16 sets of scores. This gave a good picture of the average scores and the scatter of scores made on each test by the sample of 150 students.

After computing the correlation matrix between all 16 sets of scores, the correlation matrix data was keypunched onto I.B.M. cards and fed into the computer together with a program for computing Multiple R. The M.P.D. score was used as the criterion with the remaining 15 tests and subtests acting as predictor variables. Then the program, a rather complex one, automatically computed the Beta coefficients, a Multiple R based on all 15 original predictor values, the portion of the variance predicted from each predictor, the T-tests for the Betas, and the "b" weights for all 15 factors.

This data was then used to chose the 5 most promising factors for computing a Multiple R, using the M.P.D. scores as the criterion and 5 of the remaining 15 tests and subtests as predictors. Then a stepwise regression program was used to determine the predictive value of the 5 predictor variables Using this data, a prediction table was set up to enable us to estimate a score on the M.P.D. from the scores made on our 5 predictor variables.

Upon the completion of the Multiple R computations, phase two of the study started. All students scoring 1 standard deviation above or below the mean on the M.P.D. test were selected to serve as the sample for this portion of the study. Each member of the sample was administered the California Test of Personality, Primary Level, in a small group testing session (3-8 persons) and their scores computed. Then the Chi-Square technique was used to determine whether or not a person's score on the California Test of Personality and its subtests is contingent upon his perceptual stability, as measured by the M.P.D. Persons were divided into 2 categories on the basis of their M.P.D. scores, those scoring 1 standard deviation or more above the mean and those scoring 1 standard deviation or more below the mean. With respect to the California Test of Personality, the subsample was divided into 2 groups with the criterion for placement being a score above or below the national mean on the California Test. See Figure 2. Chi-Square was computed and checked for significance.

	Above M on Cal. T. of Pers.	Below M on Cal. T. of Pers.
+1 Std. Dev. on M.P.D.		
-1 Std. Dev. on M.P.D.		

Figure 2

Then the sample was expanded to include the 34 persons who had the highest scores on the M.P.D. and the 34 persons who had the lowest scores on the M.P.D. This group was subdivided two ways:

1. On the basis of whether they scored in the lowest or highest group on the M.P.D.
2. On the basis of whether they scored above or below the expanded sample (N - 68) mean score on the C.T.P.

The Chi-Square technique was used to determine the relationship between a high or low score on the M.P.D. and a student's score on the C.T.P.

Then the reading and work study skills scores, as measured by the Iowa Basic Skills Tests (administered in October, 1966) were obtained through an inspection of records for the subsample of persons scoring + - 1 std. dev. from the mean on the M.P.D. Again the Chi-Square technique was used to determine whether or not a persons's score on the Iowa Reading Test or Work Study Skills Test was contingent upon his perceptual stability, as measured by the M.P.D. The subsample was divided on the basis of their M.P.D. scores as noted above to determine the expected vertical cell frequencies. The expected horizontal cell frequencies were determined by dividing the subsample into two groups based on whether their reading and work study skills scores were above or below the national mean. See Figures 3 and 4.

	Above M. on Reading	Below M. on Reading
+1 Std. Dev. on M.P.D.		
-1 STD. DEV. on M.P.D.		

Figure 3

	Above M. on Study Skills	Below M. on Study Skills
+1 Std. Dev. on M.P.D.		
-1 Std. Dev. on M.P.D.		

FIGURE 4

Then Chi-Square was computed with both sets of data and tests for significance applied.

After this procedure had been completed, similar techniques were applied to a sample composed of all persons who had taken the M.P.D. for whom reading and work study skills test scores were available. This sample was subdivided:

1. On the basis of whether a person scored above or below the sample mean(98) on the M.P.D.
2. On the basis of whether a person scored above or below the national mean(3.1) on the reading and work study skills test scores.

The Chi-Square technique was used to determine the relationship between scores on the M.P.D.. and scores on the reading and work study skills tests. The significance of the Chi-Square values was again determined. This marked the end of phase two in our plan for collecting and processing data on the M.P.D.

In phase one, correlational and multiple correlational techniques had been used to determine the relationship between scores on the M.P.D. and selected intellectual and perceptual measures, with the results being tested for significance. In phase 2, the Chi-Square technique was used to determine whether a person's reading skill, work study skills, or personality traits were related to his perceptual stability, as measured by the M.P.D. The results obtained with the Chi-Square technique were also tested for significance.

When the collection and processing of the data had been completed, the task of organizing and presenting the data in understandable form began. All pertinent data was organized and presented in tables of frequency distributions. These were introduced either in the main body of the study or placed in an appendix, depending on the importance and complexity of the data. Where appropriate, graphic presentations of the data were made by means of frequency polygons, charts, or figures.

A written explanation of all data presented accompanied that data upon its introduction into the main body of the study. Pertinent relationships were pointed out and essential inferences drawn.

Finally, in the last chapter, an attempt was made to draw all the threads of the study into a whole fabric. Conclusions were drawn, based on the data presented, and a list of recommendations based on these conclusions was established.

DESCRIPTION OF TESTING INSTRUMENTS USED - THEIR RELIABILITY AND VALIDITY

Of the five tests used in this study the Frostig and the M.P.D. are classed as tests of visual perception while the Lorge-Thorndike and Progressive Matrices, are classed as intelligence or scholastic aptitude tests. The PMA is considered a multiple-aptitude test.

THE MINNESOTA PERCEPTO-DIAGNOSTIC TEST

The M.P.D. test is easy to administer and score. Although it is used as an individual test for the purpose of this study, it can also be used as a group test, albeit not in the sense in which this term is often understood. "It is possible for one test administrator to test three subjects at a time but with a team of administrators (4 ro 5) working as a coordinated team it is possible to administer the test to about 30 subjects in a time space of about 20 minutes. Some subjects completed the test in about five minutes, whereas, some subjects needed about 20 minutes."[3]

The reliability of the M.P.D. according to the manual is "sufficiently high for the clinician to have confidence that a subject upon retesting will remain in the same diagnostic category. Ninety-one percent of the normals and brain damaged upon retest remained in their original diagnostic category."[4]

The manual points out that large fluctuations of scores are expected because the greater the pathology, the more fluid the perception. However, the test-retest reliabilities as computed by the Pearson correlation method, still range from a low of .71 for organics to .89 for normal children. For an instrument of this type, the reliability is quite satisfactory.

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[3]Russell S. Ende, An Application of a Perceptual Test to School, A Report Presented at the Symposium on the Clinical Application and Remedial Use of a Perceptual Test in the Identification and Treatment of Learning Disorders in School Children, at the Annual Meeting of the American Psychological Association in Chicago, 1965. p. 14

[4]Gerald B. Fuller and James T. Laird, "The Minnesota Percepto-Diagnostic Test," Journal of Clinical Psychology, Monograph Supplement, Vol. XIX, No. 16 (January, 1963), p. 15.

The rationale behind the test seems borne out by the several studies of the concurrent validity of the test reported in the manual. When used to discriminate between normal persons, persons with severe personality disturbances, and persons with organic brain damage, the tests correctly identified from 78% to 100% of the persons in each category. While this same high validity ratio may not persist when the test is widely used in the field, later studies seem to bear out its validity.[5]

Richard Coan, reporting on the M.P.D. in The Sixth Mental Measurements Yearbook, states "...Fuller and Laird have succeeded in devising an instrument that discriminates well between normals and functionally disturbed individuals and between the latter and the organically brain damaged. At least in comparison with other instruments that serve this purpose, the M.P.D. displays quite satisfactory validity."[6]

Studies conducted subsequent to the publication of the test manual and cited in Chapter II seem to bear out the findings on reliability and validity reported in the manual.

For the purpose of this study, a change in the scoring procedures of the M.P.D. was introduced to provide for easier statistical computations. Instead of giving a person a score of 1 if he rotates 1°, a score of 24 will be given for rotating 1°. A person who rotates 25° or more will receive a

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[5]Above, Chapter II, this study.

[6]Richard W. Coan, "Minnesota Percepto-Diagnostic Test," The Sixth Mental Measurements Yearbook, ed. Oscar Buros, (Highland Park, New Jersey: The Gryphon Press, 1965) p. 471.

score of 0. A person rotating 10° would receive a score of 15 and so on. Thus, a person rotating all figures 25° or more would thus get a score of 0, rather than 150. By using this scoring system, negative correlations between this test and other tests will be shown by a negative coefficient of correlation, and positive correlations will be indicated by positive coefficients of correlation. This should help eliminate confusion since the M.P.D is a test which if traditionally scored would yield a high score for poor performance and vice versa.

FROSTIG TEST OF VISUAL PERCEPTION

While this test definitely needs further research and standardization on a much wider scale, reliability and validity correlations do show promise. Test-retest reliability of the perceptual quotient was reported as .80 for a sample of 35 first graders and 37 second graders tested two weeks apart. Subtest scale score test-retest correlations ranged from .42 to .80. Split half reliability correlation coefficients computed on 1459 children aged 5 to 9 ranged from .78 to .89.

Validity in a test of this nature is difficult to assess because there is no clear cut criterion with which to correlate results on the test. However, the following correlations between the Frostig test and the criteria indicated yielded the product moment coefficient of correlation shown:

Classroom Adjustment	.441
Motor Coordination	.502
Intellectual Functioning	.497
Goodenough Scores	.32 to .46

In addition, it also appears to have some validity in identifying poor readers and children with severe learning difficulties although no studies are cited in the manual.

Product-moment correlations of subtest scores by grade level seem to indicate that all five subtests do measure separate perceptual factors. This is especially true at the third grade level where correlations between the parts range from .0 to .32.[7]

THE LORGE-THORNDIKE I.Q. TEST

In addition to its role in measuring "g", the Lorge-Thorndike I.Q. test was also used as an instrument to classify students according to intellectual ability for the purpose of this study. The New Multi-Level Edition of this test (copyright 1964) was used and the test was administered by classroom teachers trained in its use. All results were machine scored and answer sheets were carefully checked by the principal of each school prior to submission for scoring.

The 1957 version of this test from which the current version was adopted, was praised by Frank S. Freeman in Buros' Fifth Mental Measurements Yearbook with these words, "This 1957 version of the Lorge-Thorndike Intelligence Test is among the best group tests available, from the point of view of the psy-

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[7]Marianne Frostig, Phyllis Maslow, D. Welty Lefever, John R. B. Whittlesey, The Marianne Frostig Developmental Test of Visual Perception, 1963 Standardization (Palo Alto, California: Consulting Psychologists Press, 1964) p. 487.

chological constructs upon which it is based and that of statistical standardization."[8] Freeman, together with Milholland and Pidgeon, the other critics of this test, go on to cite this test as excellent in the following aspects: item selection, scale development, standardization, use of deviation I.Q.'s, reliability, validity, and completeness and accuracy of manual.[9] The odd-even reliability correlation coefficients obtained from the standardization sample data on the Lorge-Thorndike ranged from .920 to .955 on the verbal battery and from .900 to .943 on the nonverbal battery. On two alternate forms reliability studies conducted in Maryland, correlation coefficients on the verbal battery ranged from .833 to .939 and from .797 to .923 on the nonverbal battery.[10]

The new Multi-Level Edition (1964) of the Lorge-Thorndike test is based on the old separate level edition of the test, but has been updated with new items added and out of date or poor items removed. The restandardization took

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[8] Norman Frederiksen, "SRA Primary Mental Abilities," The Fifth Mental Measurements Yearbook, ed. Oscar Buros, (Highland Park, New Jersey: The Gryphon Press, 1959) pp. 709-714.

[9] John E. Milholland, "Lorge-Thorndike Intelligence Tests," The Fifth Mental Measurements Yearbook, ed. Oscar Buros, (Highland Park, New Jersey: The Gryphon Press, 1959) pp. 481-482.

D. A. Pidgeon, "Lorge-Thorndike Intelligence Tests," The Fifth Mental Measurements Yearbook, ed. Oscar Buros, (Highland Park, New Jersey: The Gryphon Press, 1959) pp. 482-484.

[10] Irving Lorge, Robert L. Thorndike, and Elizabeth Hagen, Lorge-Thorndike Intelligence Tests Technical Manual, Multi-Level Edition, (Boston: Houghton Mifflin Company, 1966) pp. 9-11.

place in fall of 1963 and involved a stratified sample of 190,000 students. Thus the norms are current, and representative of the U.S. as a whole. This, in conjunction with modern statistical procedures, provides a type of construct validity in itself.

The standard error of measurement on the Lorge-Thorndike in points of deviation I.Q. was found to range from a low of 2.4 on test level A, score level 45, to a high of 6.1 at test level E, score level 65. Most of the standard error values clustered in the 3.0 to 5.0 range. The National Mean was set at 100 with a standard deviation of 16 points at all levels.

Validity of three types is also well documented in the technical manual, i.e. representative, predictive, and construct validity. By representative validity, the test manual authors seem to be referring to what is commonly called content or face validity. The proof of this validity consists of a rationale indicating the thinking behind the test's design and construction. Most noteworthy is the concept that the test is designed to be a power test of abstract and general intelligence.

Several studies indicating the relationship between scores on the Lorge-Thorndike test and various achievement test batteries are reported. One of the most significant of these included all 4th grade students in a Midwestern town of 80,000 persons. Here the correlation coefficient ranged from .726 to .839 when correlating the Lorge-Thorndike verbal battery results with results from five subtests and the composite score on the Iowa Every Pupil tests. Comparison of the nonverbal battery with these same six measures on the Iowa tests yielded correlations of from .580 to .679. These results were typical of most of the studies reported. The highest series of correlation coefficients were found between scores on Lorge-Thorndike and California Achievement tests (.57 to .96). While some studies showed lower correlations than those cited, the vast majority of correlations reported were .6 or higher.

Correlations between school grades and Lorge-Thorndike scores ranged from .39 to .76 on two reported studies, ($N_s = 411,834$) with the median correlation being .52. In a third study ($N = 139$) the correlation between rank in class and Lorge-Thorndike I.Q. test scores was found to be .56.

Construct validity was proved largely by correlations between the Lorge-Thorndike and the following I.Q. tests: California Test of Mental Maturity (.79), Kuhlman Anderson (.77), Otis (.84), Standford- Binet (.79), Wisc (.83), Wais (.78), SAT (.81), PSAT (.85), and ACTP (.77). All correlations noted are between the verbal section of the Lorge-Thorndike and the verbal section of the corresponding test. Performance correlations were somewhat lower, but the correlation between the total Lorge-Thorndike score and the total score on the other tests was just slightly below the level for verbal correlations.[11]

All evidence then indicates that the Lorge-Thorndike I.Q. test is a well built instrument and suited to our purpose in this study. After classifying the students on the basis of I.Q., the I.Q. scores in the verbal and nonverbal batteries were used together with the total I.Q. score to compute correlations.

RAVEN'S STANDARD PROGRESSIVE MATRICES

The Progressive Matrices were developed in Great Britain by Raven in 1938 as a measure of Spearman's "g" factor. Consisting of 60 matrices or

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[11] Ibid., pp. 17-29.

designs, from each of which a part has been removed, this test requires the eduction of relations among abstract items. Test items are grouped in five series, each containing 12 matrices of increasing difficulty which are similar in principle.

A minor revision of the test was made in 1956; this involved changing one item and changing the order of a few items. Other than this, the test is essentially the same as it was in 1938. Anastasi remarks regarding this test, "On the whole, the Progressive Matrices show considerable promise for a variety of testing purposes, but more systematic data is needed on norms, reliability at different levels, and validity."[12]

The manual does an inadequate job of presenting facts on reliability and validity. A table gives the test-retest reliability for 5 age level brackets extending for 13 years to 50 and over, giving a range of correlations of .83 to .93. Unfortunately the author doesn't mention where or how he got these figures.

As far as validity is concerned, the manual cites only correlations between the Progressive Matrices and the Mill Hill Vocabulary Test. These range from .44 to .60 for the five age brackets mentioned previously.

Fortunately, however, many investigations have been published that provide relevant data on this test. A review of these studies indicates a retest reliability of between approximately .70 and .90 for groups of older children and adults moderately homogenious in age. But reliability falls considerably below these values at the lower score ranges.

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[12]Anne Anastasi, Psychological Testing (2nd Ed.; New York: The MacMillan Co., 1961) p. 263.

Correlations range between .40 and .75 with both verbal and performance tests although correlations tend to be higher with performance tests. Predictive validity coefficients with academic standing as the criteria, run somewhat low, but studies with mental defectives and with different occupational and educational groups seem to indicate fair concurrent and predictive validity.[13]

While this test is almost 30 years old it has only recently begun to achieve prominence in the U.S. The primary reasons for its inclusion in this test is its seemingly high loading in factor "g". However, the fact that it has shown some promise in the detection of organic brain damage is not to be overlooked.[14]

PRIMARY MENTAL ABILITIES TEST

The current form of the PMA was standardized in April, 1962, based on a representative national sample of 32,708 children ranging in age from 4.5 to 20 years.

Reliability data obtained from a study in a North Carolina public school system is reported in the technical manual for the PMA test. The test-retest method of computing reliability was used with the reliability coefficients for each grade level from K. to Gr. 12 being computed separately. Each

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[13] H. R. Burke, "Raven's Progressive Matrices: A Review and Critical Evaluation," Journal of Genetics Psychology, Vol. XCIII(September, 1958), pp. 199-228.

[14] Raymond B. Evans and Jessie Marmorston, "Scoring Raven's Coloured Progressive Matrices to Differentiate Brain Damage," Journal of Clinical Psychology, Vol. XIX(July, 1964), pp. 360-364.

grade level group was retested once after a 1 week interval and then again after a 4 week interval. The reliability coefficients reported range from .84 to .94 with the majority falling around .90.

There are also available specific reliability data on the use of the PMA 2-4 test for the third grade level. The technical manual reports that the test-retest reliability coefficient for a group of North Carolina third grade children was .93 when the two testings took place 1 week apart. When the retest took place 4 weeks after the original test, the reliability coefficient was .92.[15]

The manual does not mention the size of the sample used to determine the reliability coefficients except to say it was "not large". No other reliability studies are reported in the manual. It goes without saying that the representativeness of the sample used to estimate reliability leaves much to be desired, as does the inaccurate reporting of sample size.

It would have been preferable to have several large samples from various parts of the country, but at least the reliability data available appears acceptable. This is, if the "not (too) large" sample was not too small.

Validity data for the PMA batteries were obtained from four schools, one each from Alabama, Massachusetts, Missouri, and Ohio. Included were a total of 2,558 students; 1734 in grades 1-8, and 824 in high school. Course grades from the end of the following school year were used for criterion data. These were obtained fourteen months after testing with a few exceptions. Validity coefficients were computed separately for each grade at each school.

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[15] Primary Mental Abilities Technical Report (Chicago: Science Research Associates Inc., 1965) pp. 14-17.

The validity coefficients ranged from a low of .30 in grade 12 to a high of .47 in grade 11 at the one high school surveyed. In the three grade schools surveyed, validity coefficients were computed for each grade level at each school. They ranged from .38 to .78. The specific validity correlation coefficients obtained at the third grade level are reported below:

SCHOOL	GR.	N	COEFF.
School A	3	45	.38
School B	3	91	.67
School C	3	81	.69

Grades obtained by students at the four schools providing the validity study sample were also correlated with the performance of the students on the various subtests of the PMA. Rather than go into a detailed description of the results it would be sufficient merely to indicate that the correlation coefficients at the elementary level were about as expected, falling largely in the .30 to .60 range. The correlations found between subtests such as Verbal Meaning and subjects such as Reading and Language Arts were generally higher than those found between unrelated subtests and subjects. However, there were no strikingly high relationships uncovered. Correlation coefficients between PMA subtest scores and subject grades at the high school level were much lower, and three low negative correlations were uncovered.[16]

At one elementary school (grades 2 to 7) correlations were run between Kuhlman - Anderson scores and PMA scores with the following results:

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[16]Ibid., pp. 18-20.

GRADE	2	3	4	5	6	7
TOTAL PMA - K.A. "r"	.66	.48	.69	.80	.76	.76
N	45	56	55	59	58	20

Correlations run between the PMA tests and the Iowa Tests of Basic Skills Composite Score at the same school yielded the following results:[17]

GRADE	5	6	7
TOTAL PMA - ITBS "r"	.84	.80	.75
N	69	58	61

In addition to the above indications of validity must be added the fact that the test was standardized on a fairly large and representative sample. This in itself furnishes a proof of a type of construct validity.

To sum up, it must be stated that while the data on reliability and validity reported in the technical manual looks promising, much more data would be desirable in a test aimed at national usage. In terms of technical and statistical excellence the PMA cannot compare with the Lorge-Thorndike or similar instruments. However, it still remains a very useful tool with good norms and good (if insufficient) reliability and validity data.

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[17]Ibid., p. 21.

CHAPTER IV

THE EXPERIMENTAL DATA

SCORES ON THE LORGE-THORNDIKE

In order to serve as a basis for comparison with scores made by the pre-selected sample on the tests used for this study, the Lorge-Thorndike scores (total I.Q.) for the entire third grade population were arranged into a frequency distribution(Table 8). The district mean, as previously mentioned was 104.4(total I.Q. score) with an I.Q. range of 59 to 143. While the mean score for this group was somewhat above the national average, the range of abilities covered was quite large. In addition, when graphically plotted in the form of a histogram, it can be seen that the scores approximated a normal curve (Graph 1). It is not the classic example of a normal curve, but it can be seen that moving just a few cases from one interval to the next interval would have made it so.

Table 9 contains the frequency distribution of the scores made on the Lorge-Thorndike I.Q. test by the sample selected for our study. The mean total I.Q. of the sample was 104.5, with a range of 59 to 143. The standard error of the mean was 1.192 and the standard deviation stood at 14.609. That this sample was representative of the total population from which it was drawn can best be indicated by comparing the histogram drawn from this frequency distribution (Table 9) with the histogram drawn to represent the total population(Graph 2). The two are quite similar, but not identical due to the prolems encountered in getting a perfect sample. It also approaches a normal curve.

Table 8

Distributions of Score of Entire Third Grade Population of Addison, Illinois, on Lorge-Thorndike Intelligence Test(Total I.Q.).

Int. No.	Freq. Int.	N	Int. No.	Freq. Int.	N
1.	147-151	0	11.	97-101	55
2.	142-146	1	12.	92-96	45
3.	137-141	1	13.	87-91	40
4.	132-136	9	14.	82-86	16
5.	127-131	17	15.	77-81	14
6.	122-126	19	16.	72-76	4
7.	117-121	41	17.	67-71	0
8.	112-116	41	18.	62-66	1
9.	107-111	39	19.	57-61	1
10.	102-106	62			
				TOTAL =	406

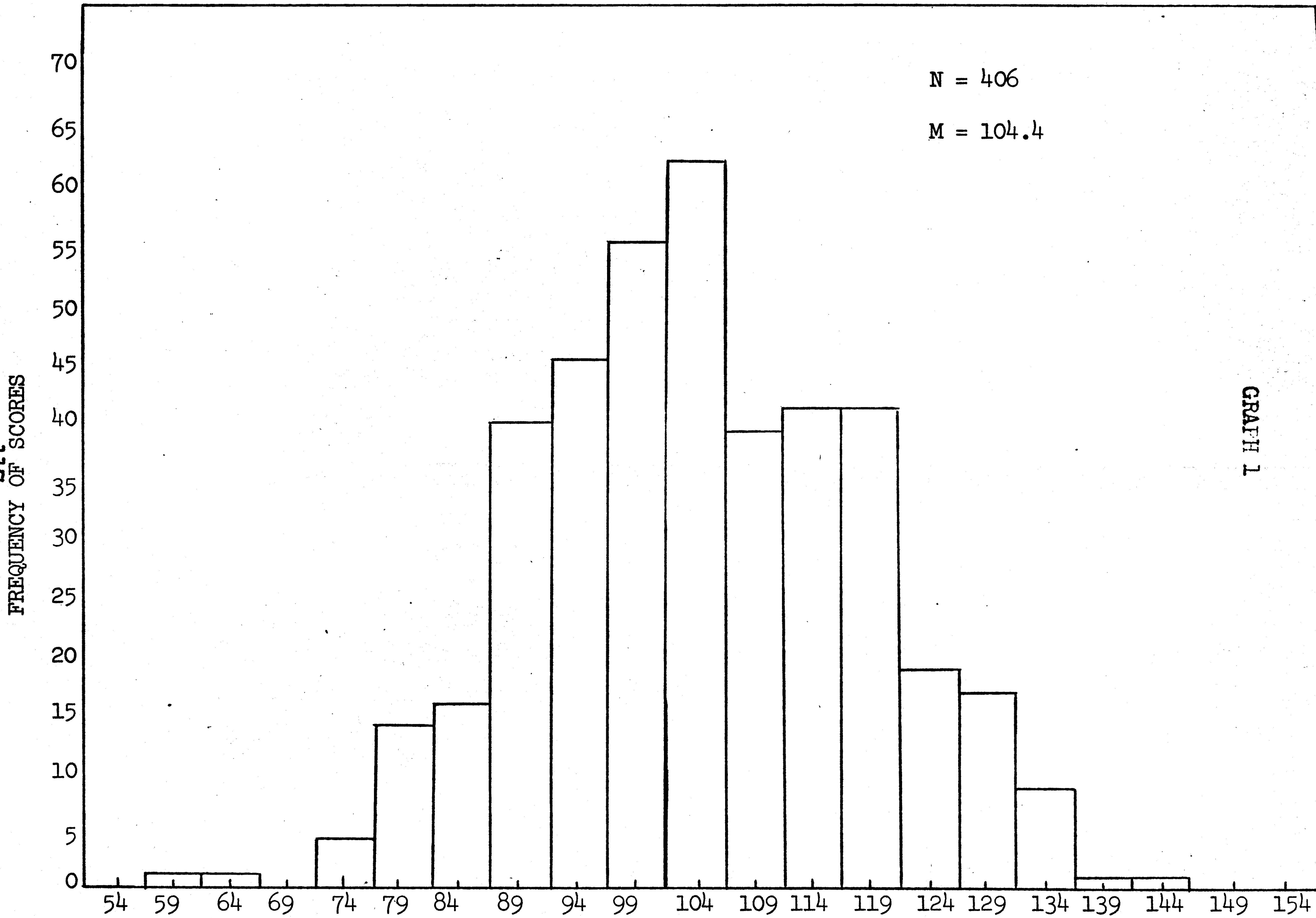
Range 59 to 143

Table 9

Frequency Distributions of Scores Made on Lorge-Thorndike Intelligence Test (Total I.Q.) by Sample.

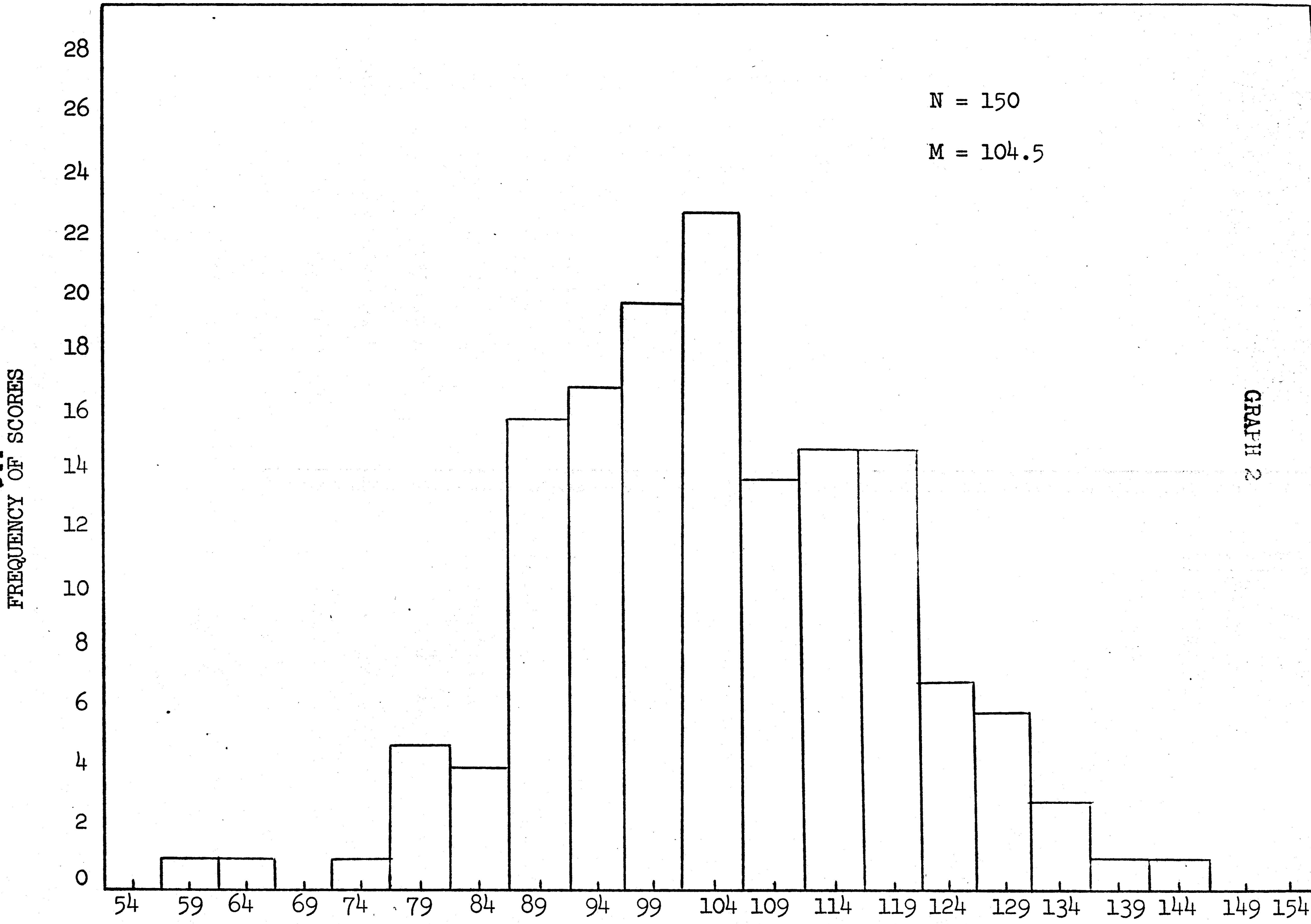
Int. Nol	X	N	Int. No.	X	N
1.	147-151	0	11.	97-101	20
2.	142-146	1	12.	92-96	17
3.	137-141	1	13.	87-91	16
4.	132-136	3	14.	82-86	4
5.	127-131	6	15.	77-81	5
6.	122-126	7	16.	72-76	1
7.	117-121	15	17.	67-71	0
8.	112-116	15	18.	62-66	1
9.	107-111	14	19.	57-61	1
10.	102-106	23			
				TOTAL N =	150

Range 59 to 143



HISTOGRAM OF ENTIRE THIRD GRADE POPULATION

GRAPH 1



HISTOGRAM OF THIRD GRADE SAMPLE

GRAPH 2

DISTRIBUTION OF M.P.D. SCORES

The histogram drawn from the scores made on the M.P.D. (Graph 3) presents an entirely different picture however. The scores are evenly distributed, but the distribution is negatively skewed to a marked degree. This impression is borne out by an inspection of the frequency distribution table of the M.P.D. scores made by the Sample (Table 10). An inference which can be drawn from this fact is that while the majority of the students sampled have attained at least a fair measure of proficiency in whatever ability or abilities are measured by the M.P.D., a sizable minority had not attained even minimal proficiency.

The range of ability in terms of degrees of rotation is larger than the range of scores on any of the other tests administered. This is not totally due to a lack of potential range on the other tests. The PMA in particular had many more items than 150. It rather seems to be an indication that the M.P.D., at least with our group, samples a factor or factors in which a given group of children at the third grade level are deficient.

The mean score on the M.P.D. was 98.4, with a standard error of 1.694 and a standard deviation of 20.8. The large standard error and standard deviation are further indications of the wide spread of scores made on the M.P.D. Were the scores to be interpreted merely in terms of the mean and standard deviation with a distribution so negatively skewed, it is obvious that many inequities would result.

SCORES ON THE FROSTIG TEST

An inspection of the frequency distribution (Table 11) and histogram (Graph 4) for the Frostig test indicated that the scores made on the Frostig

Table 10

Frequency Distribution of Scores Made on Minnesota Percepto-Diagnostic Test by Sample

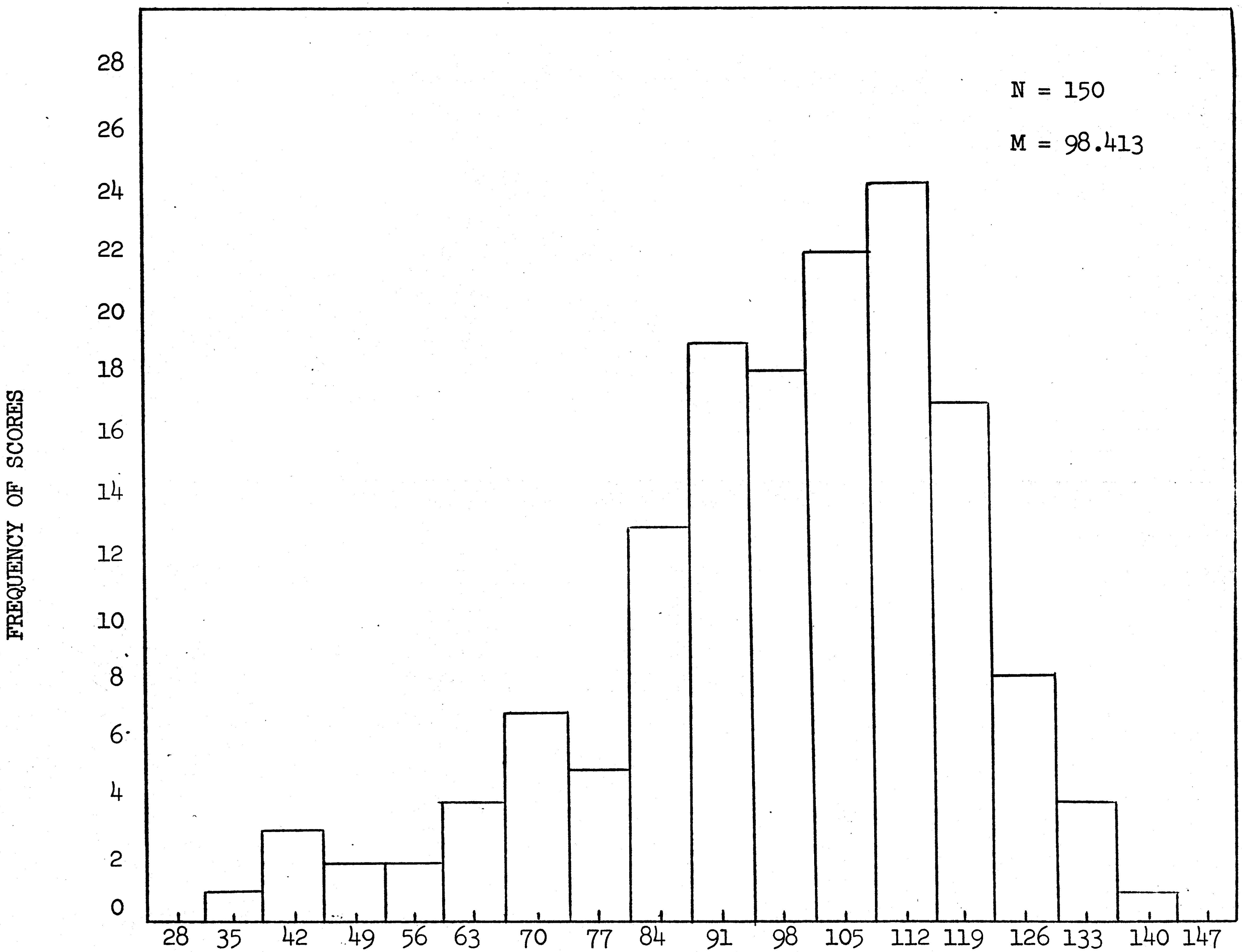
Interval No.	X	N	Interval No.		N
1.	137-143	1	9.	81-87	13
2.	130 -136	4	10.	74-80	5
3.	123-129	8	11.	67-73	7
4.	116-122	17	12.	60-66	4
5.	109-115	24	13.	53-59	2
6.	102-108	22	14.	46-52	2
7.	95-101	18	15.	39-45	3
8.	88-94	19	16.	32-38	1
			TOTAL N	=	150

Table 11

Frequency Distribution of Scores(Total) Made on Frostig Test by Sample

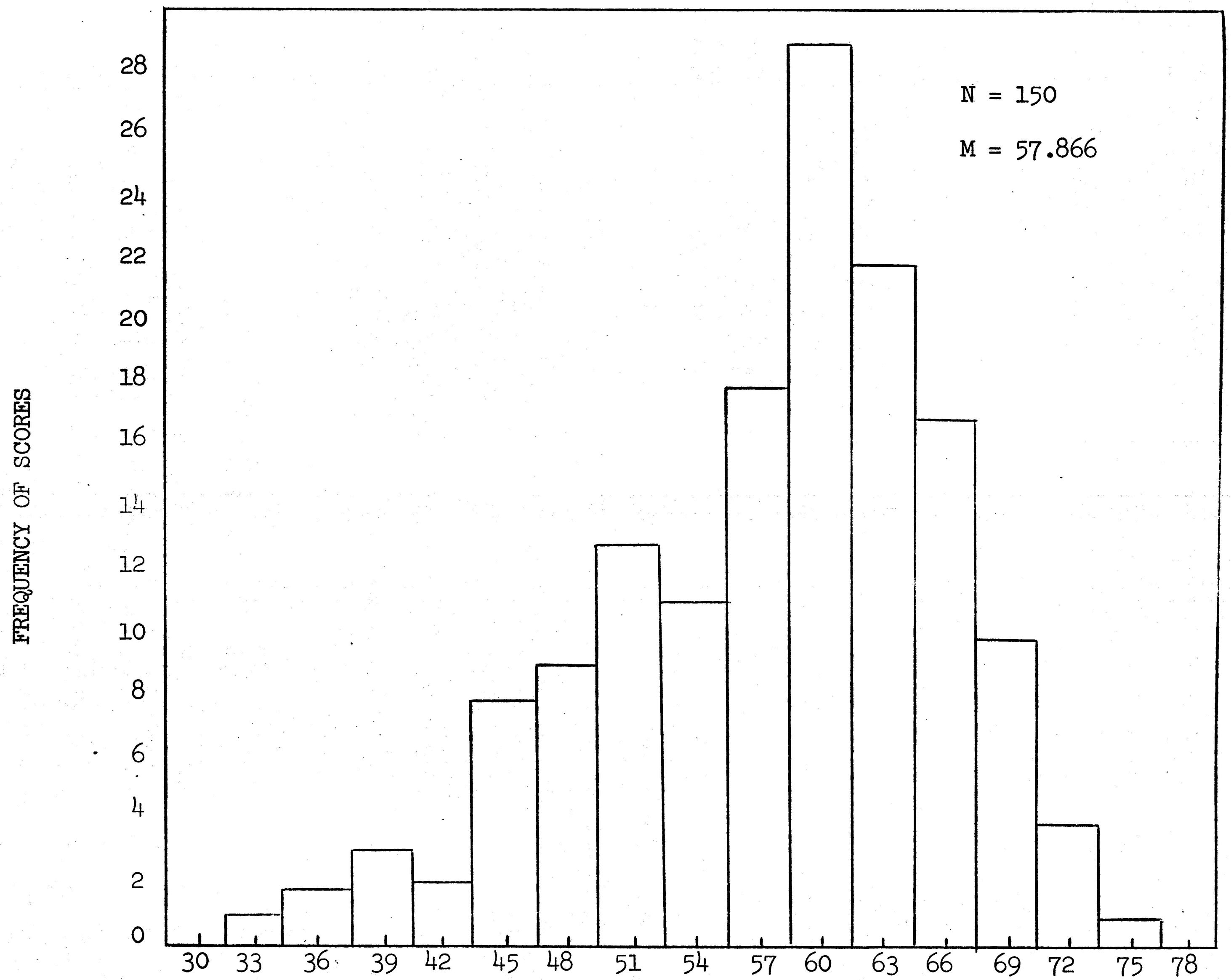
Interval No.	X	N	Interval No.	X	N
1.	74-76	1	9.	50-52	13
2.	71-73	4	10.	47-49	9
3.	68-70	10	11.	44-46	8
4.	65-68	17	12.	41-43	2
5.	62-64	22	13.	38-40	3
6.	59-61	29	14.	35-37	2
7.	56-58	18	15.	32-34	1
8.	53-55	11			
			TOTAL N	=	150

GRAPH 3



HISTOGRAM OF M.P.D. SCORES MADE BY SAMPLE

GRAPH 4



HISTOGRAM OF FROSTIG TEST SCORES MADE BY SAMPLE test also form a curve that is negatively skewed. The skewness is not as pronounced, however, as with the M.P.D. The scores falling within and above the interval 59 to 61 form a steep symmetrical pattern, while the scores falling below 59 form a typically skewed pattern.

It is interesting to note that negatively skewed curves were formed with the scores made by our sample on the M.P.D. and Frostig tests. Both of these tests purport to measure perceptual factors, and are designed to be tools used in the diagnosis of perceptual handicap and brain damage. Moreover, the manual for each test indicates that a distribution such as we found is to be expected. The reason is that while most persons develop their perceptual abilities evenly and are close to perceptual maturity at Grade 3, a given proportion do not. This proportion is normally much further behind their peer group in perceptual acuity than in intellectual ability. That such a phenomenon should occur in our testing program lends at least some degree of credence to the construct validity of both tests.

The mean score on the Frostig test was 57.9 with a standard error of the mean of .678 and a standard deviation of 8.309. The range of scores extended from 34 to 75.

PROGRESSIVE MATRICES SCORES

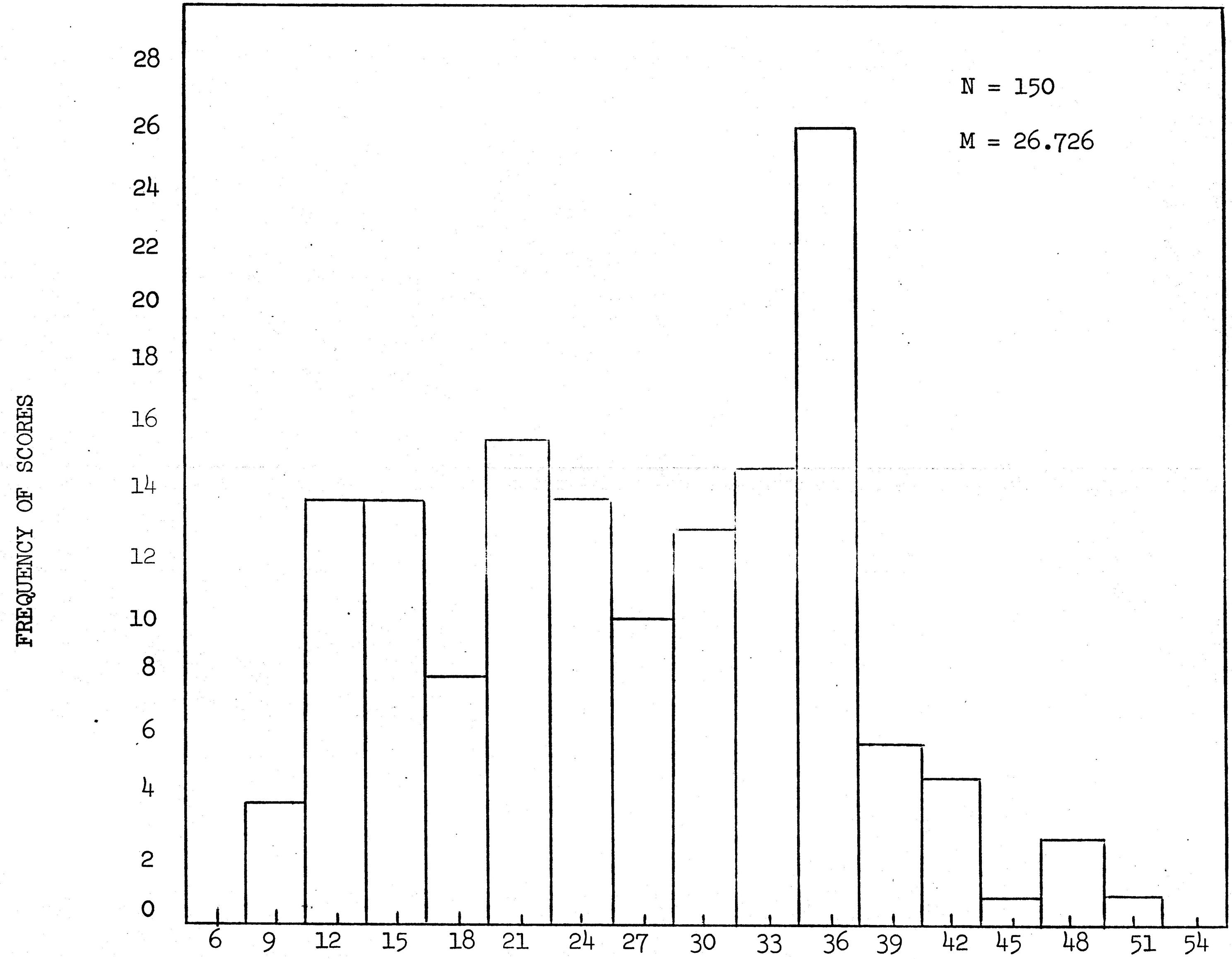
An inspection of the scores made on the Progressive Matrices yields a highly different picture of our sample than that seen in Graphs 2, 3, and 4. The distribution of scores obtained on the Progressive Matrices test (Table 12) when graphically plotted indicates a distribution far from normal (Graph 5). We have here what amounts to a platykurtic distribution with the one large deviation coming at the interval 35-37 and a scattered sprinkling of scores at the upper limits of the distribution. The reasons for such a distribution are not known, but it may be that the eduction of logical relationships essential to taking a test of this nature was too difficult for third grade children. Once beyond the simple patterns, many children resorted to guessing and failed to develop a consistent method of attacking the problems. A few children took to the test amazingly well, however, as indicated by one girl who got a score of 51 out of 60 correct (99 percentile).

The mean score made on the Progressive Matrices was 26.7 with a standard error of the mean of .810 and standard deviation of 9.9.

Table 12

Frequency Distribution of Scores Made on Progressive Matrices Test by Sample

Interval No.	X	N	Interval No.	X	N
1.	50-52	1	9.	26-28	10
2.	47-49	3	10.	23-25	14
3.	44-46	1	11.	20-22	16
4.	41-43	5	12.	17-19	8
5.	38-40	6	13.	14-16	14
6.	35-37	26	14.	11-13	14
7.	32-34	15	15.	8-10	4
8.	29-31	13		TOTAL N =	150



HISTOGRAM OF PROGRESSIVE MATRICES SCORES MADE BY SAMPLE

GRAPH 5

PRIMARY MENTAL ABILITIES SCORES

The Primary Mental Abilities test had the largest number of questions (197) and hence the largest potential range of scores. The actual range of scores made on the test, however, was only 102 points, ranging from a low of 73 to a high of 175. The frequency distribution formed by the scores on the P.M.A. formed a curve roughly approximating a normal curve with negative skewness as indicated by Table 13 and Graph 6. It is obvious, however, that the approximation to a normal distribution was quite rough in spots, especially in those intervals falling below the mean.

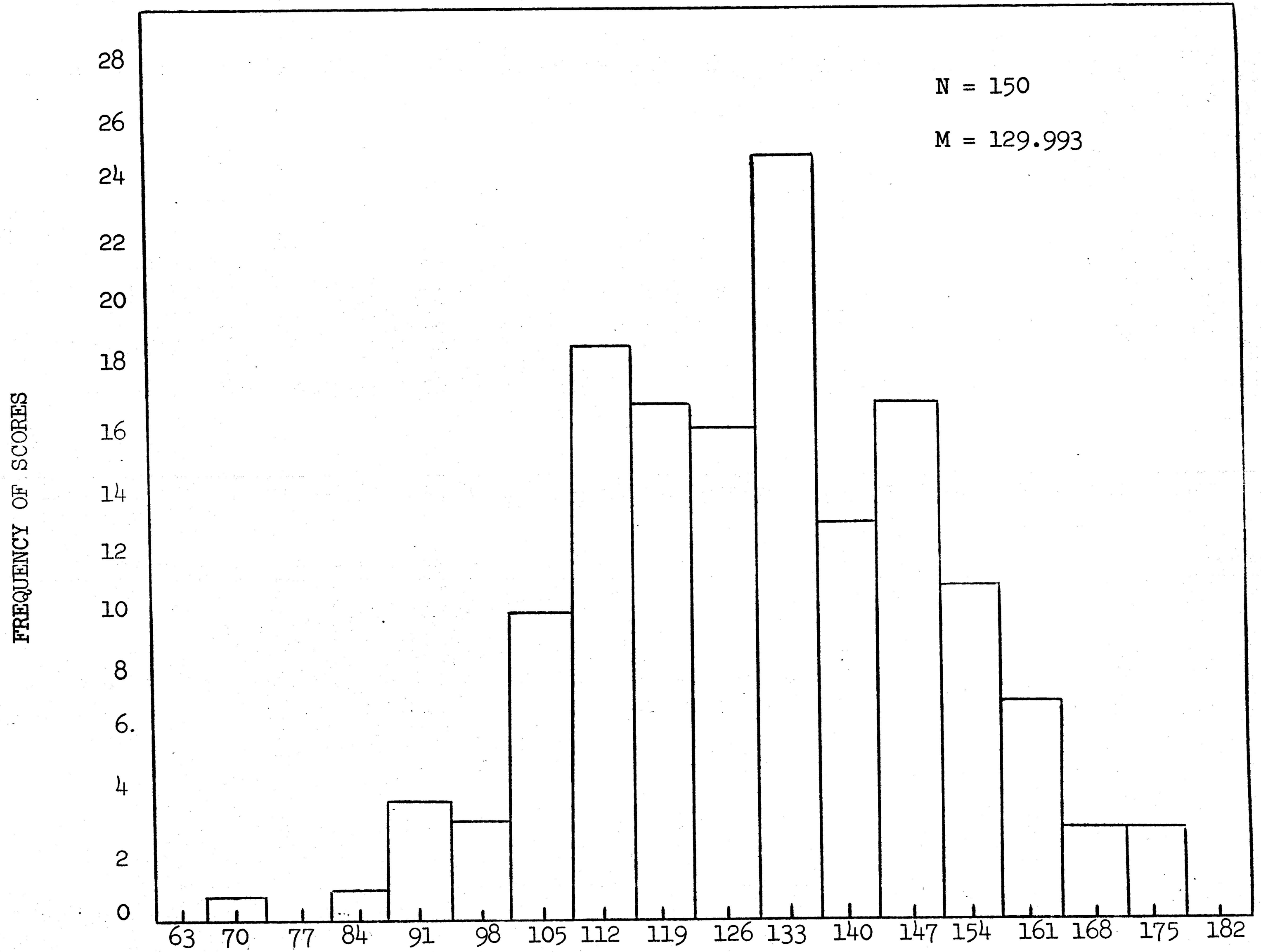
Table 13

Frequency Distribution of Scores Made on Primary Mental Abilities Test by Sample

Int. No.	X	N	Int. No.	X	N
1.	172-178	3	9.	116-122	17
2.	165-171	3	10.	109-115	19
3.	158-164	7	11.	102-108	10
4.	151-157	11	12.	95-101	3
5.	144-150	17	13.	88-94	4
6.	137-143	13	14.	81-87	1
7.	130-136	25	15.	74-80	0
8.	123-129	16	16.	67-73	1
				TOTAL N	150

The mean score made by our sample on the P.M.A. was 129.993 or 130, with a standard error of the mean of 1.6 and a standard deviation of 19.8. The Standard deviation, though high, was in keeping with the total range of scores.

GRAPH 6



HISTOGRAM OF P.M.A. SCORES MADE BY SAMPLE

The various measures of control tendency and scatter gathered on the 5 major tests used in this study are listed completely in the appendix.[1] Included with this list are all the subtests contained within the 5 major tests. However, in order to clarify our thoughts on the 6 sets of scores discussed within this chapter the following table is introduced at this point.

Table 14

Summary of Distribution

Test	N	Mean	S.E.of Mean	Std. Dev.	Range	Shape	Skewness
1.Lorge-Thorndike	406	104.4	N/A	N/A	59-143	Normal	None
2.Lorge-Thorndike	150	104.520	1.192	14.609	59-143	Normal	None
3.M.P.D.	150	98.413	1.694	20.751	33-138	Normal	Neg.
4.Frostig	150	57.866	.678	8.309	34-75	Normal	Neg.
5.Prog. Matrices	150	26.726	.810	9.927	8-51	Platy-kurtic	Slightly Pos.
6.PMA	150	129.993	1.613	19.763	73-175	Approx. Normal	Slightly Pos.

This table presents in summary form the data needed for a comparison of the distributions of scores obtained by our sample on the 5 major tests discussed thus far. In addition, it presents us with a view of the performance by the entire third grade population in District 4 on the Lorge-Thorndike test.

[1]See Appendix II.

CHAPTER V

INTERCORRELATIONS BETWEEN LORGE-THORNDIKE, PROGRESSIVE MATRICES, AND M.P.D. SCORES

An analysis of the correlation coefficients indicating the relationship between scores on the M.P.D. and on the Lorge-Thorndike and Progressive Matrices proved quite interesting, to say the least. Before entering into an analysis of the results, however, it would be best at this point to set up a correlation matrix indicating the interrelations among these tests as an aid to discussion.

Table 15

Correlation Matrix

Tests	L-T Tot.	L-T Ver.	L-T N-V	M.P.D.	P.M.
1.Lorge-Thorndike Tot.					
2.Lorge-Thorndike Verb.	.917				
3.Lorge-Thorndike Non-V.	.928	.723			
4.M.P.D.	.202	.182	.190		
5.Progressive Matrices	.547	.443	.568	.264	

The intercorrelations found between the two Lorge-Thorndike subtests and the total score are of the expected size. However, while expected, these correlation coefficients are also encouraging as an indication that we have not accidentally chosen an aberrant sample. They serve therefore as an internal check of consistency and let us know that there are no major discrepancies in intellectual ability as far as the group sampled is concerned.

The correlations between the M.P.D. and all three measures of intelligence on the Lorge-Thorndike tell a different story. The M.P.D. purports to be culture free and hence free from the influence of intelligence. However, as we noted earlier in this study, the authors state that there may be a relationship between I.Q. and rotation on the M.P.D. Thus, to summarize without prolonging the issue, it would be safe to say that at least the issue was in doubt.

The results of our current study should help resolve the doubt. The correlation coefficients between all three scores on the Lorge-Thorndike and the M.P.D. (Total .202, Verbal .182, Non Verbal .190) were significant at better than the .05 level. In addition, the correlation between the M.P.D. and the Verbal I.Q. score just missed being significant at the .01 level. Thus, it may be asserted that there does seem to be a slight significant relationship between intelligence as measured by the Lorge-Thorndike Intelligence test and whatever factor(s) are measured by the M.P.D.

The relationship between intelligence as measured by the Progressive Matrices and the factor(s) measured by the M.P.D. is even more striking. The coefficient of correlation between these two measures was .264, a correlation significant beyond the .01 level of significance. It must be pointed out however that the Progressive Matrices is not an intelligence test in the normal sense of the word. There remains a distinct possibility that perceptual factors may be highly related to success both on the Progressive Matrices and the M.P.D.

The fact remains however that there appears to be a significant relationship between intelligence both as measured by the Lorge-Thorndike and by the Progressive Matrices and success on the M.P.D. Should the relationship between intelligence and success on the M.P.D. remain significant when other measures of intelligence are used, this fact would have to be taken into account when evaluating any results on the M.P.D. While it is true that the authors of the test recommend the use of the M.P.D. only for persons with an I.Q. between 80 and 115, their recommendations do not hold water for 2 reasons:

1. The authors do not say what intelligence test should be given under what conditions to derive the I.Q. score used as a guide.
2. To be a truly effective screening instrument, a test should be able to deal with all I.Q. ranges.

For these reasons, the author felt it essential to test the relationship between success on the M.P.D. and intelligence over the entire range of I.Q.

The correlation coefficients expressing the relationship between the three Lorge-Thorndike I.Q. test scores and the Progressive Matrices were all in the area of .5 to .6 (Total .547, Verbal .443, Non-Verbal .568). These are extremely significant, but not large enough to indicate that both tests were measuring the same factors. In view of this, we are led to two unalterable conclusions:

1. The correlation coefficients are too low to uphold the contention that both the Progressive Matrices and the Lorge-Thorndike measure the "g" factor as directly as they purport to do. Both tests do appear to measure a certain factor(s) in common, but a correlation of only .5 leaves a high degree of variance unaccounted for by the "g" factor alone. The variance may be due to additional specific factors measured by one test or the other.
2. It would also appear from these correlations that each test may be related to factors accounting for different aspects of the total variance contained within the criterion score.

CHAPTER VI

INTERCORRELATIONS BETWEEN THE FROSTIG, P.M.A., AND M.P.D. TESTS

The deceptiveness of the face or content validity of any test is a well known fact. Once again, however, the current study reemphasizes the need to closely inspect the claims made for any test. In comparing the correlation coefficients obtained between the Frostig test and its subtests, the PMA test and its subtests, and the M.P.D. we find proof of that point. In several cases a test or subtest supposedly measuring a given factor has a low correlation with another test or subtest purporting to measure the same factor. While the reasons for these low correlations may be many and varied, they do, nonetheless, tend to discredit the face validity of the test or subtest in question.

To further bring out this point and to aid in our discussion of the various relationships uncovered by correlational techniques between the Frostig test, the PMA, the M.P.D., and all subtests thereof a correlation matrix is included at this point. In Table 16 are plotted all the intercorrelations between the tests and subtests mentioned. It is interesting to note on this chart for example, the low correlation between the total scores on the Frostig test and the scores on the M.P.D. Both of these tests purport to measure perceptual factors but the correlation between them is only .171. While the figure is significant beyond the .05 level of significance, it is still much

Table 16

	1. FROSTIG - Total Score	2. FROSTIG - Eye-Motor	3. FROSTIG - Figure-Ground	4. FROSTIG - Form Constancy	5. FROSTIG - Position in Space	6. FROSTIG - Spatial Relations	7. P.M.A. - Total	8. P.M.A. - Verbal	9. P.M.A. - Spatial Relations	10. P.M.A. - Number Facility	11. P.M.A. - Perceptual Speed	12. M.P.D.
1. FROSTIG-Total Score												
2. FROSTIG-Eye-Motor	.703											
3. FROSTIG-Figure Ground	.750	.311										
4. FROSTIG-Form Constancy	.799	.291	.501									
5. FROSTIG-Position in Space	.258	.078	.192	.162								
6. FROSTIG-Spatial Relations	.465	.176	.340	.394	.065							
7. P.M.A.-Total	.544	.250	.344	.568	.282	.402						
8. P.M.A.-Verbal	.371	.154	.225	.442	.162	.139	.666					
9. P.M.A.-Spatial Relations	.441	.199	.291	.458	.246	.287	.617	.331				
10. P.M.A.-Number Facility	.472	.234	.318	.456	.196	.427	.837	.374	.377			
11. P.M.A.-Perceptual Speed	.268	.118	.133	.294	.225	.221	.686	.346	.327	.369		
12. M.P.D.	.171	.153	.087	.108	.194	.097	.311	.235	.275	.188	.250	

INTERCORRELATIONS BETWEEN FROSTIG, PMA, AND M.P.D. SCORES lower than that normally found between two intelligence tests. It also raises a question as to exactly what these two "pure" tests of perception do measure.

A slightly more favorable relationship exists between the PMA subtest called Spatial Relations and the Frostig subtest called Spatial Relations. A correlation of .287 between the two subtests is significant beyond the .01 level, and in view of the shortness of each subtest is fairly good. Were the Frostig and PMA subtests to be lengthened through the addition of items at intermediate and higher levels, this correlation could have been higher. As it was, the Frostig subtests proved to be too short and to have too low a ceiling. Both subtests suffered from a lack of discriminatory items. Moreover, it should be noted that both tests had a higher correlation with the total Lorge-Thorndike score than with each other. Thus while there is a significant correlation between the two Spatial Relations subtests, both measures are related more closely to intelligence than to each other.

One secondary but encouraging note was the low intercorrelations found among the various subtests in the Frostig test. While all factors except position in space correlated well with the total Frostig score, the intercorrelations were uniformly low. This lends some credence to the Frostig test's claim that it measures 4 separate perceptual factors. The claim still cannot be substantiated on the basis of this evidence especially in view of the questionable reliabilities of such short subtests. However, the subtests could be lengthened and it does appear that this area is worth exploring in further studies. Should the low intercorrelations remain with longer subtests of proven reliability, the discriminatory value of the Frostig test could be invaluable in diagnostic work.

Unfortunately, only the Position in Space subtest of the Frostig test was significantly correlated (.194) with the M.P.D. and this at the .05 level. However, three subtests of the PMA and the total PMA score correlated with the M.P.D. test at better than the .01 level of confidence. The fourth subtest, Number Facility, correlated with the M.P.D. at the .05 level. One reason for the higher correlation of PMA subtests with the M.P.D. as opposed to Frostig subtests undoubtedly lies with the length of the PMA subtests. They contain many more items than the Frostig subtests and in addition some subtests are timed. Both the added length and the timing factor increase reliability and thus indirectly heighten the correlations in question.

The intercorrelations found between the PMA subtests were in the range of .327 to .377 as was noted in Chapter II. Correlations of the subtests with the total PMA score ranged from .617 to .837.

Intercorrelations between the Frostig test and the PMA test and their various subtests ranged from .118 to .472.

In summary then, it must be stated that the range and size of the intercorrelations found among the M.P.D., PMA, and Frostig tests and their subtests are about as expected in a study of this nature. The one surprise, however, lies in the low intercorrelations found between the M.P.D. and the scores on the five Frostig subtests and the total Frostig score. Both tests purport to measure perception and claim validity in the detection of brain damage. If in fact it does prove that both tests are valid, it would seem that they achieve their validity by measuring entirely different factors.

CHAPTER VII

APPLICATION OF MULTIPLE CORRELATIONAL TECHNIQUE TO EXPERIMENTAL DATA

COMPUTATION OF MULTIPLE R WITH 15 PREDICTOR VARIABLES

After completing the analysis of the ~~individual~~ relationships discovered between the 16 tests, ~~and subtests utilized in the first portion of this study,~~ the data was prepared for analysis through MANOVA ~~multiple correlational~~ techniques. A correlation matrix was prepared which included the 15 predictor variables and the criterion variable. From This matrix ~~was keypunched on to cards and fed into the computer~~ together with a ~~program designed to determine~~ the beta weights, the "B" weights and the portion of variance predicted from each predictor while computing Multiple R. was determined. T-tests for the betas were also computed.

The results of these computations are included in Table ~~17~~ 5. Use of all predictor variables yielded a Multiple R-Squared of .1573022 and a Multiple R of .3966134. An "F" of 1.6675 was obtained with D.F. 1 = 15 and D.F. 2 = 134. While this figure is not significant, it just misses at the .05 level.

All 15 predictor variables taken together were able to account for only 16% of the variance. This figure is extremely important inasmuch as it indicates that 84% of the variance is still unaccounted for. Thus, while a small portion of the variance is attributable to common perceptual and intellectual factors, the larger portion is not. It would seem therefore that the

M.P.D. is not measuring intelligence or perception. It is true that the size of Multiple R Squared and of Multiple R are lowered by the 5 factors which make a negative contribution to the portion of variance predicted by all 15 factors.

Table 17

Analysis of Variance on M.P.D. Predicted by 15 Predictor Variables

Predictor Variable	Beta	Portion of Var. Predicted from each Predictor	T-Test for Beta	"B" Weights
1.Lorge-Thorndike Total	.1382080	.0279180	.190319	.059637
2.Lorge-Thorndike Verbal	.0124286	.0022620	.031452	.005220
3.Lorge-Thorndike Non-Verbal	-.0859213	-.0163250	-.203704	-.033208
4.Frostig Total	-.0076864	-.0013143	-.009800	-.002339
5.Frostig Eye-Motor	.1212292	.0185480	.337776	.092017
6.Frostig Figure-Ground	-.0215746	-.0018769	-.076040	-.036735
7.Frostig Form-Constancy	-.1647458	-.0177925	-.445570	-.370678
8.Frostig Position in Space	.0946301	.0183582	.895834	.161127
9.Frostig Spatial Relations	.0131918	.0012769	.114076	.138514
10.Progressive Matrices	.0916922	.0242067	.782520	.825230
11. PMA Total	.3755200	.1167867	.521655	.238967
12.PMA Verbal	.0143000	.0033605	.063376	.004573
13.PMA Spatial Relations	.0815586	.0224286	.440649	.090143
14.PMA Number Facility	-.2202423	-.0414055	-.557604	-.322680
15.PMA Perceptual Speed	.0034729	.0008682	.014033	.002083

By dropping those factors with negative Betas and disregarding those factors with insignificant loadings, it is possible to raise Multiple R to a more respectable figure (Table 18).

However, even if it were certain that all these figures were significant, not even 21% of the total variance would have been accounted for. And such a procedure is highly questionable because relationships so slight could easily have been negative or insignificant. They could in fact have resulted from chance relationships or even been the result of both tests measuring error variance. Thus, the Multiple R of .3966134 resulting from computations using all 15 predictor variables appears to be the more realistic figure.

Table 18

Variance Predicted by Positive Predictor Variables

FACTOR		Portion of Variance Predicted (B x coeff.)
Lorge-Thorndike Total		.0279180
Frostig Eye-Motor		.0185480
Frostig Position in Space		.0183582
Progressive Matrices		.0242067
P.M.A. Total		.1167867
P.M.A. Spatial Relations		.0224286
	Mult. R^2 =	.2082462
	Mult. R = .456	

That the M.P.D. is not measuring intelligence seems borne out by the low correlation (.202) found between the Lorge-Thorndike and the M.P.D. and by the small portion of variance (.0279180) predicted by the Lorge-Thorndike. The portions of the variance predicted by the Progressive Matrices and the Lorge-Thorndike verbal and non-verbal are even smaller. From this, ~~we~~ one can see that the relationship between scores on the M.P.D. and intelligence seems to be just slightly above chance.

~~Oddly enough~~ T this also seems to be the case with those tests specifically designed to measure perceptual factors. The portion of variance predicted by the Frostig test and its 5 subtests is negligible and/or negative. The PMA subtest of Perceptual Speed also accounts for a negligible portion of the variance, while the Spatial Relations subtest of the PMA predicts only a little over 2 percent of the variance.

Just one score, the PMA Total, accounts for any sizeable portion (.1167867) of the variance of the M.P.D. The PMA is a multiple aptitude inventory composed of 4 subtests: Verbal, Spatial Relations, Number Facility, and Perceptual Speed. The fact that none of its subtests predicted any sizeable portion of the variance while the total score did, seems to indicate that the portion of the variance predicted by the PMA corresponds to a type of complex general ability which includes intellectual and perceptual acuity.

In view of the above, one must conclude that ~~we are f~~orced to this conclusion. A score on the M.P.D. is ~~just~~ not highly related to intelligence or perception~~, as currently conceived~~.

In an attempt to test this inference further, a decision was made to select the 5 most promising variables from the original 15 predictor variables for further analysis in a ~~stepwise~~ regression program. This move was also undertaken to determine if a manageable set of regression weights capable of predicting M.P.D. scores could be arrived at.

The variables selected and the portion of variance predicted by each are as follows:

Table 19

Variance Predicted by 5 Most Significant Predictor Variables

Variable	Portion of Variance Predicted
1.Lorge-Thorndike	.0279180
2.Progressive Matrices	.0242067
3.PMA Total	.1167867
4.PMA Spatial Relations	.0224286
5.PMA Number Facility	-.0414055

The first 4 predictor variables were selected, because of their relatively high positive loading. Numerical ability was chosen in spite of its negative loading in the hope that it might act as a repressor variable.

Based on the factors included in this table, a correlation matrix including the 5 predictor variables and the criterion variable~~,~~ was drawn up, ~~and keypunched onto I.B.M. cards~~. The matrix cards were then fed into the computer with a program yielding a stepwise regression equation. The weighted degrees of freedom were equal to 150 and the F level to enter and remove a variable set at .0100.

~~The computer program rejected~~ Variables 1 and 5, Lorge-Thorndike Total and PMA Number Facility respectively, were rejected because they did not contribute enough variance to reach the .0100 F level. Variables 2, 3, and 4 were accepted ~~by the computer~~ and entered into the problem in numerical order. The calculated regression weights are included below:

Table 20

Regression Weights of 3 Most Significant Predictor Variables

Variable	Coefficient	Standard Error of Coefficient
2.Progressive Matrices	.451748069	.1850500492
3.PMA Total	.4065138407	.0779489905
4.PMA Spatial Relations	1.2030946030	.3539735886

F Level = 11.55, Significant at .05 level

Mult. R^2 = .1634220

R = .404

Theoretically if the scores obtained by a person on the Progressive Matrices, the PMA Total, and the PMA Spatial Relations were multiplied by the coefficient for each and the products added together, the result would be an approximation of his score on the M.P.D. Because of the low relationship between the predictors and the criterion, the approximation would be very rough. This fact was proven by use of the coefficients for several sets of scores selected at random. The relationship between these 3 scores and the M.P.D. score was significant at the .05 level.

It would appear then that the analysis of the data obtained in ~~phase one~~ ~~of~~ this study by MANOVA ~~multiple correlational~~ techniques leads one ~~us~~ to the following conclusions:

1. The scores on conventional measures of intelligence and perception, such as the Lorge-Thorndike, Progressive Matrices, and Frostig, account for an insignificant portion of the variance on the M.P.D.
2. Only the total score on the PMA, a multi-aptitude battery, appears to predict any sizable portion of the variance on the M.P.D.
3. With the current set of predictor variables, it appears impossible to construct a set of regression weights with the capability of accurately predicting the criterion score.

CHAPTER VIII

THE RELATIONSHIP BETWEEN THE CALIFORNIA TEST OF PERSONALITY AND THE M.P.D

The California Test of Personality is a paper and pencil test of personality in which no attempt is made to conceal the purpose of the test. As such, it has certain built in limitations. Chief among these is the tendency for any person, even a child, to answer in terms of what they consider to be socially acceptable. In addition, the California Test of Personality possesses other limitations which are a product of its specific makeup. But yet it has enough good features so that we are forced to agree with Sims when he says that, "All in all, in spite of criticism, as personality inventories go, the California Test would appear to be among the better ones available."[1]

Essentially the California Test of Personality (C.T.P.) consists of a series of 96 questions; 48 questions deal with a person's personal adjustment and 48 other questions deal with his social adjustment. Each question is designed to be answered "yes" or "no".

The category of personal adjustment is further subdivided into: self-reliance, sense of personal worth, sense of personal freedom feeling of belonging, withdrawing tendencies, and nervous symptoms. The category of social adjustment is also divided into six subcategories, namely: social standards,

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[1]Verner M. Sims, "California Test of Personality," The Fifth Mental Measurements Yearbook, ed. Oscar Buros, (Highland Park, New Jersey: The Gryphon Press, 1959) pp. 101-103.

social skills, anti-social tendencies, family relations, school relations, and community relations. Each of the six subcategories contained within the two major categories consists of eight questions designed to measure a person's feelings in that area. Four levels of the test are available; for the purpose of this study, the primary level (K-3) was used.

To the credit of the test makers they make no claim that the subcategories measure general traits. They consider them as only the names of more or less specific tendencies to feel, think, and act. In keeping with this rationale we shall make no attempt to analyze our findings in terms of specific traits or factors of behavior.

At the primary level the reliability coefficients computed by means of the Kuder-Richardson formula with an "N" of 255 were .83 for the personal adjustment category and .80 for the social adjustment category. The reliability coefficients for the six subcategories of personal adjustment ranged from .70 to .87. In the social adjustment category, the range of reliability coefficients ran from .51 to .82 for the subcategories. For the total inventory, the reliability coefficient was .88.

Content and construct validity are based on the care taken in the construction and norming of the test, and the reported usefulness of the test as a training device for teachers, as an aid to counselors, psychologists and teachers in the study of problem cases, and as a useful tool in personality research. No direct mention is made of concurrent or predictive validity in the manual, but several validity studies have been made with the C.T.P. and are reported in the administration manual (1953)[2] and the technical manual (1950).[3] Both the Fifth and Sixth Mental Measurements Yearbooks contain references to a large number of more recent studies of all types.

An example of a recent study done on the C.T.P. is Semler's study of the relationship between the C.T.P. and several other measures of pupil adjustment. The results of his work indicated a positive relationship significant at the .05 level between a score on the C.T.P. and scores on two measures of peer acceptance and one teacher rating scale.[4]

An example of an older validity study conducted on the C.T.P. is that done by Jackson in 1946. Jackson found the C.T.P. more effective than interviews, experience ratings, teacher ratings, and parent ratings in identifying student traits in his study.[5]

Norms for the C.T.P. at the primary level are based on the results of a study of 4,500 pupils in grades K-3 inclusive in South Carolina, Ohio, Colorado, and California. Scores are yielded in terms of percentiles, standard

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[2]Louis P. Thorpe, Willis W. Clark, and Ernest W. Tieges, California Test of Personality (Monterey, California: California Test Bureau, 1953).

[3]Editorial Staff, "Summary of Investigations," California Test of Personality (Monterey, California: California Test Bureau, 1950).

[4]Ira J. Semler, "Relationships Among Several Measures of Pupil Adjustment," Journal of Educational Psychology, Vol. LI, No. 2(1960) pp. 60-64.

[5]Joseph Jackson, "The Relative Effectiveness of Paper-Pencil Test, Interview, and Ratings as Techniques for Personality Evaluation," Journal of Social Psychology, Vol. XXIII, (February, 1946), pp. 35-54.

scores, or raw scores. Due to the small number of items in each subcategory and the relatively high standard error of the mean, it is impossible to meaningfully compare subtest scores for one individual, although such subtest scores would have meaning for a large group. The larger number of items (48) contained in each of the major categories gives greater significance to either an individual or group score.

A correlation matrix including the total adjustment score, the two major categories, and all twelve subcategories is included in the manual and is reproduced below:

Table 21

INTERCORRELATIONS OF TEST SECTIONS CALIFORNIA TEST OF PERSONALITY - PRIMARY
(237 Pupils - Grades 1-3)

	1B	1C	1D	1E	1F	2A	2B	2C	2D	2E	2F	T1	T2	T
1A	.30	.27	.38	.45	.34	.30	.33	.36	.30	.39	.27	.64*	.44	.60*
1B		.43	.58	.49	.25	.37	.30	.35	.39	.46	.37	.73*	.52	.67*
1C			.40	.39	.24	.33	.29	.33	.31	.43	.33	.63*	.46	.59*
1D				.51	.35	.40	.31	.38	.43	.53	.40	.76*	.56	.71*
1E					.47	.34	.29	.53	.20	.48	.39	.82*	.52	.73*
1F						.19	.22	.30	.17	.34	.29	.65*	.35	.54*
2A							.42	.47	.41	.43	.35	.46	.71*	.63*
2B								.48	.32	.48	.38	.41	.71*	.61*
2C									.35	.58	.46	.54	.79*	.71*
2D										.55	.42	.43	.70*	.59*
2E											.57	.62	.83*	.78*
2F												.49	.73*	.65*
T1													.68	.92*
T2														.92*
T														

*Since some subtest scores are also included in certain other summary scores against which they are correlated, these coefficients are spuriously high.

Because the subtests each contain only eight questions, intercorrelations found must be approached with extreme caution. There were three basic reasons why the C.T.P. was chosen for use in this study:

1. Technically speaking, it appears to be the best test of its type suitable for use with third grade students.
2. Its use in a wide variety of types of experiemental studies has indicated its applicability to research.
3. It did not appear that its limitations would seriously affect the objectives of the study.

In an attempt to analyze the data derived from the C.T.P. as comprehensively as possible, the relationship between a score on the M.P.D. and a score on the C.T.P was investigated for 2 separate but related samples. First the relationship was tested with a sample made up of all persons in our original study sample of 150 scoring one standard deviation above or below the mean on the M.P.D. There was a total of 36 persons in this sample; 19 below the mean, and 17 above. Then the relationship was tested using a sample composed of those persons with the 34 highest and the 34 lowest scores on the M.P.D. The Chi-Square technique was used to determine the relationship involved, with each sample being divided in the following two ways:

1. On the basis of whether they scored 1 standard deviation above or below the mean on the M.P.D. (or whether they were in the top 34 or bottom 34 scores on the M.P.D., with the second sample.
2. On the basis of whether they scored above or below the sample mean for their particular sample on the C.T.P.

The complete calculations are contained in the appendix,[6] but a resume of the findings is included in the table following.

Table 22

Relationships Between C.T.P. and M.P.D. Scores for Mixed Samples

Relationship Tested	Type of Rel.	N	Value of X^2	Level of Significance
1.Pers. Adj. C.T.P. - M.P.D.	Neg.	36	2.80	.10
2.Soc. Adj. C.T.P. - M.P.D.	Neg.	36	.446	.70
3.Tot. Adj. C.T.P. - M.P.D.	Neg.	36	2.80	.10
4.Pers. Adj. C.T.P. - M.P.D.	Neg.	68	.240	.70
5.Soc. Adj. C.T.P. - M.P.D.	Neg.	68	.242	.70
6.Tot. Adj. C.T.P. - M.P.D.	Neg.	68	2.904	.10

The averages of the 12 subsections of the test were also computed for both samples, but in all cases the difference in mean scores between those who did well on the M.P.D. and those who did poorly was insignificant.

At first indication, the results reported above would seem to indicate that persons who did well on the M.P.D. are more poorly adjusted than those who did poorly. Personal and total adjustment as reported on the C.T.P. seem to be negatively related to success on the M.P.D. Although the highest level of significance reported is only .10, if the samples were to be doubled in size and the reported ratios maintained, the Chi-Square values obtained would seem to clearly indicate a false premise in the M.P.D. rationale.

With such puzzling findings, it appeared time to do some reality testing. Fortunately, several of the children included in both samples were well known to the author. Others were known personally by principals and teachers in the

[6] See Appendix III, p. 179.

district. As a result, the answers given by those persons whose backgrounds were known, were thoroughly analyzed. Based on teacher and administrator knowledge of the children, it appeared that persons who did well on the M.P.D. honestly depicted their true adjustment on the C.T.P., often with amazing clarity. Many of those who did poorly on the M.P.D. painted their world through rose colored glasses. As a group, the responses of these persons mirrored socially acceptable answers which were completely out of step with objective reality. For example, children with very poor adjustments to school and classmates answered in a manner that would indicate good adjustment.

Conversely persons doing well on the M.P.D. seemed able to pick out areas of good and poor adjustment in their lives. They saw poor family relationships for what they were.

As a consequence it appears that the true meaning of our data is that persons scoring low on the M.P.D. either can't or won't accurately portray reality. Such an inference is of course based on these two assumptions:

1. That the sub sample analyzed is representative of the entire sample.
2. That the administrators' and teachers' view of the child's reality is reasonably objective.

Such a view implicitly raises several issues and asks questions which could possibly be answered by further research. But it does seem a reasonable way to interpret the data.

CHAPTER IX

THE RELATIONSHIP BETWEEN THE M.P.D. AND THE IOWA BASIC SKILLS READING AND WORK STUDY SKILLS TESTS

To complete the analysis of the M.P.D. test, it appeared evident that the relationship between a score on the M.P.D. and a score on a measure of reading and work study skills should be determined. However, the factors measured by an achievement test in reading and work study skills are not unitary or pure factors as was the case with the intellectual and perceptual skills measured earlier in this study. Reading ability and work study skills ability are complex skills composed of a variety of blends of unitary factors. Therefore the types of tests used to measure such abilities differ radically in makeup and objectives from intelligence and perceptual diagnostic tests which seek to measure innate traits. Achievement tests basically seek to measure a finished product and not the processes which produced that product. It is essential to bear this in mind when considering all data derived from such instruments for it directly colors the inferences we may draw from such data.

The tests selected to measure reading and work study skills ability are those contained in the Iowa Test of Basic Skills Battery(ITBS), 1964 revision. This test battery was selected because of its excellence as a testing instrument and because all District 4 students in grades 3 - 8 normally take this test every fall.

The Iowa Basic Skills Reading test (64 ed.) consists of reading selections varying in length from a few sentences to a full page. Passages used are adapted from newspapers, magazines, encyclopedias, government publications, textbooks, and literary works. The items in all of the tests from third grade on place a premium on understanding and drawing inferences from reading selections. Major skills tested include the ability to understand details, discern purpose, organize ideas, and evaluate what is read.

In order to test these skills, the items in the test are longer and more involved than most items in other current elementary school reading tests. This is a reflection on the extent to which the test attempts to measure complex skills rather than achievement per se.

While there is no subject called "work study" in the elementary curriculum, the skills sampled by this section of the ITBS xut across several of the conventional subject matter areas such as social studies and language arts. The three major work study skills tested by the ITBS are:

1. Knowledge and use of map materials.
2. Knowledge and use of graphic and tabular materials.
3. Knowledge and use of reference materials.

The map reading section attempts to test several map reading skills, particularly those involving location, distance, direction, and the reading of map legends. A wide variety of map types, including road maps, are used at each grade level.

The largest share of the subtest dealing with the reading of graphs and tables is concerned with traditional graph forms such as bar, line, and circle graphs. At least five different graphs or tables are included in the test for each grade.

Among the questions contained in the knowledge and use of reference materials sections are items dealing with the parts of a book, the globe, current magazines, the dictionary, the encyclopedia, and an atlas. The section on the use of the dictionary includes items on spelling, syllabification, accent, pronounciation, meaning, multiple meaning, and plurals. Items on the use of an encyclopedia deal with a city, a mineral, an animal, a collection of common objects, a person, and a process.

In addition to providing a separate score for each subtest in the work study skills section, a composite score based on all three subtest scores is provided as an overall measure of work study skills.

An inspection of both the reading and work study skills tests in the ITBS makes it evident that they do attempt to measure highly complex skills rather than unitary factors.

A split-halves reliability coefficient of .90 was obtained for a random sample of 2,723 children drawn from the third grade standardization group on the Iowa Reading test. For another group of 484 third grade Iowa students, an equivalent forms reliability coefficient of .85 was computed.

Using the same sample as with the reading test (2,723), a split-halves reliability coefficient of .89 was found for the total third grade work study skills scores. The equivalent forms reliability coefficient for a sample of 433 Iowa students was .83.

Split-halves reliability coefficients for the subtests of work study skills were .69 for map reading, .75 for graphs and tables, and .87 for references. Reliability coefficients of .72, .71, and .79 respectively, were obtained for these same three measures when equivalent forms were used to test reliability. Intercorrelations found between the reading test scores and work study skill scores for our sample of 2,723 third graders are reproduced below:

Table 23

Intercorrelations Between ITBS Reading and Work Study Skills Tests

Tests	R	W-1	W-2	W-3	W-T
R. Reading					
W-1 Map Reading	.65				
W-2 Graphs, Tables	.65	.60			
W-3 References	.65	.59	.62		
W-T Work Study Total	.76	.86	.87	.85	

A quick inspection of the table indicates that the reading test and the work study skills tests are measuring a large common factor(s), probably verbal ability. It is also interesting to note that the correlation between Reading and Total Work Study Skills is .76 which indicates that about 50% of the variance measured by each test is common variance.[1]

Content (curricular) validity and construct validity for the ITBS are excellent. An intensive study of school texts and curricula preceded the building of the test. Then, all items were carefully analyzed to determine whether they measured the skills they sought to measure. Herrick cites the ITBS for their excellent curricular validation.[2]

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[1]E. F. Lindquist and A. N. Hieronymus, Iowa Tests of Basic Skills (Boston: Houghton Mifflin Company, 1964), pp. 38-46.

[2]Virgil E. Herrick, "Iowa Tests of Basic Skills," The Fifth Mental Measurements Yearbook, ed. Oscar Buros, (Highland Park, New Jersey: The Gryphon Press, 1959) pp. 30-34.

Construct validity was handled through the careful selection of items and the analysis of test results coupled with excellent norming procedures. Norms for the third grade test battery were based on a national stratified sample of 18,469 students.

Concurrent validity is not mentioned in the ITBS technical manual, but predictive validity is. In a 1958 study(7), ITBS scores were secured in grades 4, 6, and 8 for pupils entering one of the two state universities in Iowa during a four year period. The zero-order and/or multiple correlations between ITBS composite or a weighted composite of the area score and (a) grade 12 composite scores on the <u>Iowa Tests of Educational Development</u>, (b) four year high school grade-point average, and (c) freshman college grade-point average were as follows:

Table 24

Predictive Validity Data on ITBS Test

		Grade 12 ITED Composite		H.S. G.P.A.	Freshman College G.P.A.	
Grade	N	r	R	R	r	R
8	1076	.73	.74	.61	.48	.49
6	772	.76	.78	.59	.49	.51
4	581	.68	.72	.53	.42	.45

In the latter two studies there was, of course, considerable restriction in range of ITBS scores. These correlations should be regarded as minimal estimates. For example, when adjustments for restriction in range are made, the zero-order correlations with ITED grade 12 composite in the latter study were .81, .82, and .77 for Grades 8, 6, and 4 respectively.

In a ten year follow up study of puils scoing in the top 5 percent of the ITBS in grade 6 in 1947 (1), 65 percent of those whose records could be traced were still above the 95th percentile on the grade 12 ITED norms six years later, 83 percent were above the 90th percentile and 96 percent were above the 75th percentile. 83 percent earned four year high school grade point averages of 3.0 or higher. Of students whose college records could be located, 53 percent earned four year college grade point averages of 3.0 or higher.

In terms of relevance, validity, reliability, and standardization the ITBS must be considered one of the better achievement tests on the market. It is in addition a well constructed and dependable tool in evaluation and research.

Unfortunately, the test results available to us were derived from tests given under normal classroom conditions. Due to the enormity of the entire achievement testing program in District 4, neither the administration nor the scoring of the reading and work study skills tests was supervised as closely as with the other tests included in this study. While this does not negate the results obtained from the tests, it does mean that we must interpret them with more caution.

The determination of the relationship between a score on the M.P.D. and a score on the Iowa reading test or Iowa work study skills test (and subtests) was accomplished in 2 phases. In phase 1, the sample consisted of only those persons who scored one standard deviation above or below the mean on the M.P.D The second phase included all those persons in the original sample selected for this study for whom achievement test scores were available.

Due to the fact that the Iowa reading test and all 3 work study skills tests measure complex skills rather than unitary traits, the use of correlational techniques seemed inappropriate at this point. The fact that the Iowa tests were not given under tightly controlled supervision also ruled against correlational techniques because of the fear that systematic or accidental errors might provide false correlations and make error variance seem to be significant difference. A rougher statistical technique which would accurately pick out relationships in rough data that might be missed or misinterpreted by correlational techniques was decided upon. The Chi-Square technique seemed to meet the specifications needed and was applied in both phases of this study.

Complete calculations covering both phases of this portion of the study are contained in the appendix.[3] To prevent confusion and a needless slowdown in interpreting the significance of the findings, only the results shall be presented in the body of this chapter.

In phase one, the sample consisted of 37 students. 19 scored 1 standare deviation or more above the mean. The reading scores and total work study skills scores were obtained for each. The a 2 way contingency table was set up in this fashion:

Reading

	3.1	-3.1
$+1\sigma$		
M.P.D.		
-1σ		

[3]See Appendix III p. 179.

The students were first divided on the basis of whether they scored 1 standard deviation above or below the mean on the M.P.D. They were then divided on the basis of whether they scored above or below 3.1 (National Mean) on the reading test. A score of 3.1 was considered to be above the mean for the purpose of this study. Using this data, a Chi-Square of 3.394 was obtained. Since there is only 1 degree of freedom in a 2 way contingency table ($df = r - 1 \times K - 1$), this figure was significant at the .10 level of significance, indicating a possible relationship between reading and an M.P.D. score.

The sample of 36 students was then divided into 2 groups based on whether or not they scored above or below the mean on the total work study skills section of the Iowa test. As with the reading tests, a two way contingency table was constructed to determine the relationship between a work study skills score and an M.P.D. score. Here, a Chi-Square of .633 was obtained, a figure which must be considered insignificant. But there was somethin unusual about the work study skill results. Those persons who had scored 1 standard deviation above the mean on the M.P.D. had an average score on the total work study skills test that was 4 points higher than the average score of those persons scoring 1 standard deviation below the mean.

So working on the theory that were there's smoke, there may be some fire, a decision was made to enlarge the sample and test all sections of the work study skills test for a possible relationship with scores on the M.P.D. Since the reading test and M.P.D. scores were significantly related at the .10 level with a small sample, it was decided to include the reading test in the expanded study.

As a result a determination was made of all those persons who had taken the M.P.D. test and whose reading and work study skills scores were available. The group was then divided on the following bases:

1. On the basis of whether or not they scored above or below the mean (.98) on the M.P.D.
2. On the basis of whether or not they scored above or below 3.1 (National Mean) on the various achievement tests.

Persons scoring 98 on the M.P.D. and 3.1 on an achievement test were considered to have scored above the mean. After dividing the group as indicated above and setting up two way contingency tables, the Chi-Square technique was used to determine the relationship between a score on the M.P.D. and scores on the various achievement tests for the larger sample. The results of these computations are included in the table below:

Table 25

Relationships Between Scores on M.P.D. and ITBS Reading and Work Study Skills

Relationship Tested	Type of Rel.	N	Value of X^2	Level of Significance
1.M.P.D. - Reading Test	Pos.	144	2.337	.20
2.M.P.D. - Map Reading	Pos.	146	6.872	.01
3.M.P.D. - Graphs & Tables	Pos.	145	.834	.50
4.M.P.D. -References	Pos.	143	.722	.50
5.M.P.D. - Work Study Total	Pos.	143	2.547	.20

As can be been only one of these relationships proved significant. Success on the M.P.D. was related to success in Map Reading at beyond the .01 level. There also seems to be a logical tie in between the M.P.D. test and the Map Reading test inasmuch as both require perceptual skills with surface similarities. It would appear therefore that success on the M.P.D. is highly related to the rather complex skill of map reading. If this is so, it would bear out the rationale of the M.P.D. test. The authors of the M.P.D. claim that the M.P.D. works because people with organic brain damage or serious personality disorders are unable to resolve the conflicts inherent when certain stimuli are presented against certain fields. A poor score in map reading would also appear to be attributable to the inability to correctly perceptualize highly structured stimuli when presented against chosen fields.

It would also appear that there may be a relationship between success on the M.P.D. and success on the Iowa Reading score. While this relationship was not clearly brought out with either sized sample, it does seem to be there. Perhaps a sample composed of a larger number of persons scoring 1 standard deviation above or below the mean on the M.P.D. would serve to clear up this problem. This might prove a source of fruitful research at a later date.

While the total work study skills score was related to the M.P.D. score at the .20 level, this is probably due only to the influence of the map reading test scores. Success on the graphs and tables test and the references test does not appear to be related to success on the M.P.D.

To summarize the findings of this entire chapter, it appears that success on the M.P.D. is positively related to success on the Iowa Map Reading test at the .01 level of significance. Also, a score on the M.P.D. may be positively related to a score on the Iowa Reading test, but this is not clearly indicated with our present sample. No other relationships were apparent.

CHAPTER X

SUMMARY AND CONCLUSIONS

In order to see the findings of the current study in true perspective, it is essential to view them in terms of a hierarchical construct. Without such a construct, the main threads of the research would become obscured by the fuzz of incidental findings and the meaning of the results impossible to decipher. Therefore, for the purpose of clarification, the findings of the present study shall be divided into first order, second order, and third order findings. The conclusions and recommendations shall also be structured in this manner.

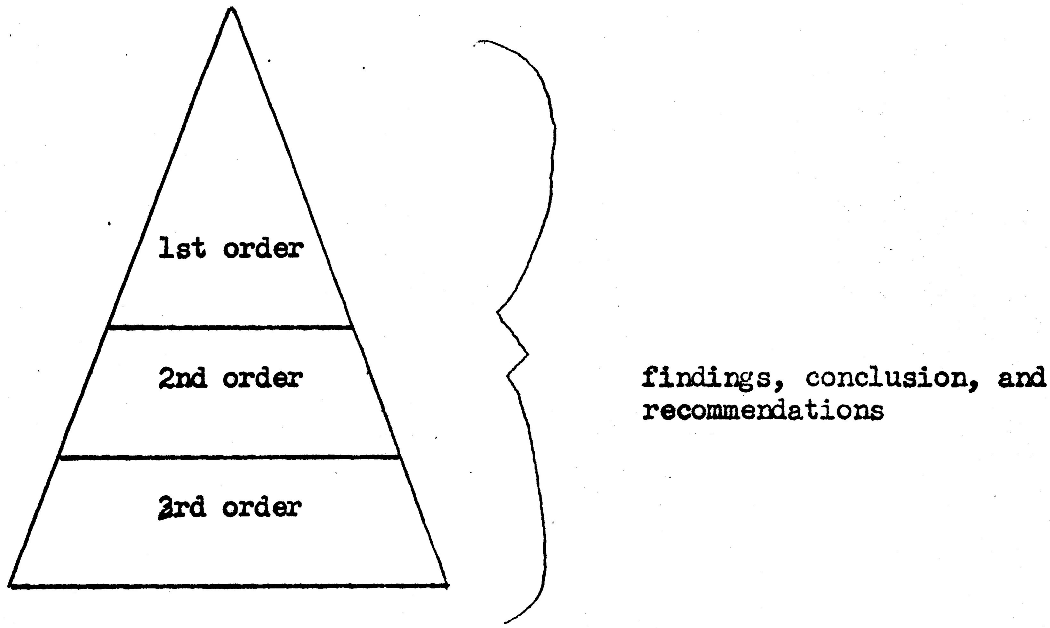
First order findings are those which relate to the major objectives set forth in this study, e.g., the relationship between intelligence and a score on the M.P.D.

Second order findings are those which relate to secondary objectives or answer questions implicit in the major assumptions or objectives underlying this study. Such a finding might deal with the interrelationship of the subtests within a test.

Finally, at the base of our triangle we have third order findings. These findings largely bear on the construct or rationale underlying the various instruments, and their relationship to each other and to reality.

If pictured graphically, our construct would appear as in Figure 5

Figure 5



FIRST ORDER FINDINGS AND CONCLUSIONS

In chapter one it was stated that the major objectives of this study would be to answer the following questions:

1. What is the extent and significance of the relationship between the M.P.D. and a series of currently defined intellectual and perceptual factors?
2. Of the fifteen tests and subtests of intelligence and perception correlated with the M.P.D., which four or five are most capable of predicting the criterion score through the use of regression weights determined by Mult. R.?
3. What is the extent of and the significance of the relationship extreme scores on the M.P.D. and scores of reading ability and study skills?

4. What is the extent of and the significance of the relationship between extreme scores on the M.P.D. and scores of personal and social adjustment?

The null hypothesis in all cases was that there were no significant relationships to be found between a score on the M.P.D. and any of the measures mentioned in questions 1 to 4. Thus, no accurate prediction tables could be set up.

All 4 questions were answered in the body of the study, but in bits and pieces. An attempt shall now be made to answer them completely in this chapter At this point it should also be noted that any conclusions drawn in the body of this chapter shall be considered applicable only to third grade public school students in Addison, Illinois, or students with similar characteristics in similar communities.

Question 1 is best answered by reference to table 26 on the following page.

From an inspection of ~~this~~ the following table we can see that the M.P.D. is significantly related to several measures of intelligence at either the .05 level or the .01 level. However, whether we consider the variance predicted by each factor individually or as one of 15 factors in a Mult. R. program, the amount of variance predicted is very small. Only the PMA Total score predicts any sizeable portion (.117) of variance.

The conclusion to be drawn ~~from this~~ is that a score on the M.P.D. is significantly related to several measures of intelligence and perception. However, the extent of the relationship in terms of variance predicted is so slight, that for all practical purposes, the influence on an M.P.D. score of intelligence or perception, as measured by ~~our~~ the instruments, must be considered negligible. It does appear however that general ability, as measured by the PMA has a moderate influence on M.P.D. scores.

Table 26

Relationships Between the 15 Predictor Variables and the M.P.D. Scores

Variable Correlated with M.P.D.	Coeff. Correl.	~~Level of~~ Sign.	Portion of Var. Pred. by Var. on Indv. Basis	Portion of Var. Pred. by Var. in Stepwise Mult. R. Equation
1.Lorge-Thorndike Total	.202	.05*	.041	.028
2.Lorge-Thorndike Verbal	.182	.05	.033	.002
3.Lorge-Thorndike Non-Verb.	.190	.05	.036	-.016
4.Frostig Total	.171	.05	.029	-.001
5.Frostig Eye-Motor	.153	No Sign.	.023	.019
6.Frostig Figure-Ground	.087	No Sign.	.008	-.002
7.Frostig Form Constancy	.108	No Sign.	.012	-.018
8.Frostig Position in Space	.194	.05	.038	.018
9.Frostig Spatial Relations	.097	No Sign.	.009	.001
10.Progressive Matrices	.264	.01**	.070	.024
11.PMA Total	.311	.01	.097	.117
12.PMA Verbal	.235	.01	.055	.003
13.PMA Spatial Relations	.275	.01	.076	.022
14.PMA Number Facility	.188	.05	.035	-.041
15.PMA Perceptual Speed	.250	.01	.063	.001

Table 26 indicates the coefficient of correlation between the M.P.D. and each of the other 15 variables together with the level of significance of each correlation. In addition, it indicates the portion of variance predicted by each of the variables both when considered independently and as one of the 15 factors in a Mult. R. equation.

~~The answer to question 2 is~~ only 3 variables appear worthy of inclusion in a prediction table used to predict M.P.D. scores. They are the Progressive Matrices, PMA Total, and PMA Spatial Relations scores. A prediction table based on these three scores is significant at the .05 level, but will at best yield only a rough approximation of an M.P.D. score. The Mult. R. for all 15 factors is only .397 and lacks significance at even the .05 level. While this Mult. R. can be increased somewhat through manipulation of the independent variables, only about 16% of the variance can be legitimately accounted for. This appears to clearly indicate that a score on the M.P.D. is not closely related to any given set of variables taken from the original group of 15 intellectual and perceptual measures.

Questions 3 and 4 are best answered by referring to Table 27. The values in table 27 apply to those persons scoring 1 standard deviation above the mean (N = 17) and those scoring 1 standard deviation below the mean (N = 19) on the M.P.D. The X^2 technique was used to test the relationship between an extreme score on the M.P.D. and a score falling above or below the sample mean on the measure indicated.

Table 27

Relationships Between Extreme M.P.D. Scores and Scores on the C.T.P. and ITBS Reading and Work Study Skills

Relationship Tested	Type of Rel.	N	Value of X^2	Level of Significance
1.Per. Adj. - C.T.P. M.P.D.	Neg.	36	2.80	.10
2.Soc. Adj.-C.T.P. M.P.D	Neg.	36	.446	.70
3.Tot. Adj. - C.T.P. M.P.D	Neg.	36	2.80	.10
4.Reading - ITBS M.P.D.	Pos.	36	3.394	.10
5.W. Stdy. Skills - ITBS M.P.D.	Pos.	36	.633	.50

The meaning derived from the data contained in table 27 is rather clear cut. There does not seem to be a significant relationship between an extreme score on the M.P.D. and a score on the C.T.P. or ITBS tests sampled. This applies of course only when scores on the C.T.P. and ITBS are grouped on the basis of whether they fall above or below the sample mean for the purpose of X computations.

The overall conclusion to be drawn from the ~~our first order~~ findings is that the M.P.D is measuring something different than the other tests. A battery of 15 intellectual and perceptual tests and subtests were able to account for only 16% of the total variance on the M.P.D. ~~and scores on the ITBS Reading and Total Study Skills test were not significantly related either.~~ Thus, it must be measuring something different, and in view of the M.P.D.'s ~~high~~ concurrent validity, that something different appears closely related to brain damage and personality disorders.

SECOND ORDER FINDINGS AND CONCLUSIONS

Among those findings not directly concerned with the primary objectives of this study but yet of sufficient importance to warrant inclusion in this chapter are the following:

1. The intercorrelations between the subtests on the PMA range from .327 to .377 while the correlations of the subtests with the total score range from .617 to .837. These facts, coupled with the relatively long length of the subtests and the high reliabilities of the PMA test and its subtests, seems to indicate that the subtests are measuring separate traits.

2. While the intercorrelations discovered between the subtests on the Frostig were uniformly low (.078 to .501), the subtests appeared too short to provide good reliability and discrimination. In addition, scoring is too subjective and amenable to the moods and attitudes of the scorer. The use of the Frostig test to measure distinct perceptual traits must be limited to highly structured situations with trained examiners.
3. The correlations found between the Spatial Relations subtest in the PMA and the Spatial Relations subtest in the Frostig was .246. This seems to indicate that they are measuring very different traits.
4. The correlations between tests of perception and of intelligence indicate that they are measuring related factors, but not identical or highly similar factors.
5. The correlations between the M.P.D. and other purported measures of perception were so low (.087 to .275) as to indicate that they are measuring entirely different aspects of perception. That is, if they both are measuring perception.
6. A further investigation of the relationship between a score on the C.T.P. and a score on the M.P.D. yielded the following results: (Table 28)

The sample consisted of the 34 persons having the highest M.P.D. score and the 34 having the lowest M.P.D. score. The members of these 2 groups were contrasted on the basis of whether they scored above or below the sample (N = 68) mean on the C.T.P. The results of this investigation indicated that there may be a negative relationship between a person's total adjustment score on the C.T.P. and a score on the M.P.D. Results, however, were not significant.

Table 28

Relationship Between Scores on M.P.D. and C.T.P.

Relationship Tested	Type of Rel.	N	Value of X^2	Level of Significance
1.Pers. Adj. on CTP - MPD	Neg.	68	.240	.70
2.Soc. Adj. on CTP - MPD	Neg.	68	.242	.70
3.Tot. Adj. on CTP - MPD	Neg.	68	2.904	.10

7. An investigation into the relationship between a score on the M.P.D. and Reading and Work Study Skills scores on the ITBS was also conducted, using as a sample all those persons who took the M.P.D. on whom ITBS scores were available. The X^2 technique was used, with the sample being divided on the basis of whether they scored above or below the mean on the M.P.D and on the ITBS. The results are listed below: (Table 29)

Table 29

Relationship Between Scores on M.P.D. and ITBS Reading and Map Skills for Entire Sample

Relationship Tested	Type of Rel.	N	Value of X^2	Level of Significance
1.M.P.D - Rdg.	Pos.	144	2.337	.20
2.M.P.D.- Map Rdg.	Pos.	146	6.872	.01
3.M.P.D.- Graphs & Tables	Pos.	145	.834	.50
4.M.P.D.- References	Pos.	143	.722	.50
5.M.P.D.- Work Study Total	Pos.	143	2.547	.20

It would appear therefore that success on the M.P.D. is significantly related to success in Map Reading on the ITBS.

8. The norms on the M.P.D. and Frostig tests have not been standardized with a sample adequate in size and representativeness. As a result, their effectiveness is hindered.

THIRD ORDER FINDINGS AND CONCLUSION

It should be noted

1. The measurement of perception and perceptual factors is still in a very rudimentary state. At the present time, the meaning of a score on a given perceptual test is very unclear.

2. There are no common reference points or overall structures in the field of perceptual measurements. Therefore, it is difficult to view perception as an integral whole with parts amenable to measurement.

3. There is a great variation in the quality of the technical aspects of test making in the field of intelligence and perception. The comparability of scores and the ability to generalize scores are destroyed when testmakers use varying criteria for establishing norms and obtaining reliability and validity data.

The evidence for all third order findings are based on the analysis and use of the tests and their technical manuals.

RECOMMENDATIONS

First Order Recommendations

1. The M.P.D. should be included in any battery of tests given elementary school students inasmuch as it measures something

unique which appears highly related to brain dysfunction and personality disorders.

2. Further research should be initiated to determine the M.P.D.'s ability to predict brain dysfunction and personality disorders both as an individual test and as a part of a battery of tests. This would necessitate a longitudinal study with clinical diagnosis of brain dysfunction and personality disorders as the criterion.
3. A factor analysis of the M.P.D. can now be initiated with the knowledge that it does measure something unique and is not unduly influenced by intellectual or other perceptual factors. A starting point for the factor analysis could be made through a comparison between the M.P.D. and the ITBS Map Study Skills to determine similarities.
4. Research should be initiated to determine if the lack of perception indicated on the M.P.D. is accompanied by a lack of perception of self and reality on the part of an individual.
5. A basic set of perceptual factors, similar to the kit of intellectual factors developed by E.T.S., should be developed and the factors named. A lot of senseless confusion is currently being created by giving identical names to apparently different factors.

Second Order Recommendations

1. New more carefully standardized norms should be provided for both the M.P.D. and Frostig tests.
2. Both the M.P.D. and Frostig should be lengthened through the provision of additional items with more precise discriminatory value.
3. The PMA should be utilized as a diagnostic instrument in the area of learning difficulties. The reliability of its subtests and the fact that they appear to measure separate factors make it an ideal tool for this purpose.
4. Research should be initiated to determine if the M.P.D. and Frostig diagnose brain dysfunction through the measurement of entirely different characteristics or if the low correlation between them is due to other factors, e.g., error variance.

Third Order Recommendations

1. A structure should be provided for the field of perception similar to that devised by Guilford for the intellect. An alternative might be a hierarchical organization of perceptual abilities similar to the Taxonomy of Intellectual Objectives. Both would add badly needed organization to the field.
2. Research should then be initiated to define the areas outlined in the structure of perception to determine the validity of the structure.
3. An organization such as the AERA or NCME should initiate a national council to determine appropriate standards for in-

telligence and perceptual tests with respect to validity, reliability, relevance, and standardization. Only tests meeting these standards would receive a seal of approval. All other tests would be considered experimental and be so designated. Further, no test should be approved for national usage which does not provide a complete technical manual.

SUMMARY

The basic worth, if any, of the current study lies with its pinpointing three major facts:

1. The M.P.D. measures something unique which can't be explained by currently defined intellectual and perceptual factors.
2. There are several profitable avenues of approach to further research in the field of perceptual measurement.
3. There is a great need for and lack of valid instruments in the field of perception.

The primary objectives of the study were exploratory rather than definitive and the findings asked as many questions as they answered. Yet hopefully it has cast some fresh light on an area which sorely needs both exploration and research.

APPENDIX I

PRELIMINARY CATEGORIES OF SIGNS AND SYMPTOMS

A. Test Performance Indicators

1. Spotty or patchy intellectual deficits. Achievement low in some areas; high in others.
2. Below mental age level on drawing tests (man, house, etc.).
3. Geometric figure drawings poor for age and measured intelligence.
4. Poor performance on block design and marble board tests.
5. Poor showing on group tests (intelligence and achievement) and daily classroom examinations which require reading.
6. Characteristic subtest patterns on the Wechsler Intelligence Scale for Children, including "scatter" within both Verbal and Performance Scales; high Verbal - low Performance; low Verbal - high Performance.

B. Impairments of Perception and Concept-Formation

1. Impaired discrimination of size.
2. Impaired discrimination of right-left and up-down.
3. Impaired tactile discriminations.
4. Poor spatial orientation.
5. Impaired orientation in time.
6. Distorted concept of body image.
7. Impaired judgment of distance.
8. Impaired discrimination of figure-ground.

9. Impaired discrimination of part-whole.
10. Frequent perceptual reversals in reading and in writing letters and numbers.
11. Poor perceptual integration. Child cannot fuse sensory impressions into meaningful entities.

C. <u>Specific Neurologic Indicators</u>

1. Few, if any, apparent gross abnormalities.
2. Many "soft", equivocal, or borderline findings.
3. Reflex assymetry frequent.
4. Frequency of mild visual or hearing impairments.
5. Strabismus.
6. Nystagmus.
7. High incidence of left, and mixed laterality and confused perception of laterality.
8. Hyperkinesis.
9. Hypokinesis.
10. General awkwardness.
11. Poor fine visual-motor coordination.

D. <u>Disorders of Speech and Communication</u>

1. Impaired discrimination of auditory stimuli.
2. Various categories of aphasia.
3. Slow language development.
4. Frequent mild hearing loss.
5. Frequent mild speech irregularities.

E. <u>Disorders of Motor Function</u>

1. Frequent athetoid, choreiform, tremulous, or rigid movement of hands.
2. Frequent delayed motor milestones.
3. General clumsiness or awkwardness.
4. Frequent tics and grimaces.
5. Poor fine or gross visual-motor coordination.
6. Hyperactivity.
7. Hypoactivity.

F. <u>Academic Achievement and Adjustment</u> (Chief complaints about the child by his parents and teachers.)

1. Reading disabilities.
2. Arithmetic disabilities.
3. Spelling disabilities.
4. Poor printing, writing, or drawing ability.
5. Variability in performance from day to day or even hour to hour.
6. Poor ability to organize work.
7. Slowness in finishing work.
8. Frequent confusion about instructions, yet success with verbal tasks.

G. <u>Disorders of Thinking Processes</u>

1. Poor ability for abstract reasoning.
2. Thinking generally concrete.
3. Difficulties in concept-formation.
4. Thinking frequently disorganized.
5. Poor short-term and long-term memory.

6. Thinking sometimes autistic.

7. Frequent though perseveration.

H. Physical Characteristics

1. Excessive drooling in the young child.

2. Thumb-sucking, nail-biting, head-banging, and teeth-grinding in the young child.

3. Food habits often peculiar.

4. Slow to toilet train.

5. Easy fatigability.

6. High frequency of enuresis.

7. Encopresis.

I. Emotional Characteristics

1. Impulsive.

2. Explosive.

3. Poor emotional and impulse control.

4. Low tolerance for frustration.

5. Reckless and uninhibited; impulsive then remorseful.

J. Sleep Characteristics

1. Body or head rocking before falling into sleep.

2. Irregular sleep patterns in the young child.

3. Excessive movement during sleep.

4. Sleep abnormally light or deep.

5. Resistance to naps and early bedtime, e.g., seems to require less sleep than average child.

K. Relationship Capacities

1. Peer group relationships generally poor.
2. Overexcitable in normal play with other children.
3. Better adjustment when playmates are limited to one or two.
4. Frequently poor judgment in social and interpersonal situations.
5. Socially bold and aggressive.
6. Inappropriate, unselective, and often excessive displays of affection.
7. Easy acceptance of others, alternating with withdrawal and shyness.
8. Excessive need to touch, cling, and hold on to others.

L. Variations of Physical Development

1. Frequent lags in developmental milestones, e.g., motor, language, etc.
2. Generalized maturational lag during early school years.
3. Physically immature; or
4. Physical development normal or advanced for age.

M. Characteristics of Social Behavior

1. Social competence frequently below average for age and measured intelligence.
2. Behavior often inappropriate for situation, and consequences apparently not foreseen.
3. Possibly negative and aggressive to authority.
4. Possibly antisocial behavior.

N. <u>Variations of Personality</u>

1. Overly gullible and easily led by peers and older youngsters.
2. Frequent rage reactions and tantrums when crossed.
3. Very sensitive to others.
4. Excessive variation in mood and responsiveness.
5. Poor adjustment to enviromental changes.
6. Sweet and even tempered, cooperative and friendly (most commonly the so-called hypokinetic child).

O. <u>Disorders of Attention and Concentration</u>

1. Short attention span for age.
2. Overly distractible for age.
3. Impaired concentration ability.
4. Motor or verbal perseveration.
5. Impaired ability to make decisions, particularly from many choices.

~~APPENDIX II~~ Table 1

	NAME OF FACTOR	N	MEAN	S.E. OF MEAN	MODE	RANGE	STD. DEV.	GROUP
1.	Lorge-Thorndike - Total I.Q.	150	104.520	1.192	104	59-143	14.609	Sample 1
2.	Lorge-Thorndike - Verb. I.Q.	150	104.133	1.230	104	57-142	15.067	Sample 1
3.	Lorge-Thorndike - N.-V. I.Q.	150	104.393	1.333	104	58-150	16.334	Sample 1
4.	Minnesota Percepto-Diagnostic	150	98.413	1.694	112	33-138	20.751	Sample 1
5.	Frostig - Total Score	150	57.866	.678	60	34-75	8.309	Sample 1
6.	Frostig - Eye-Motor Coord.	150	16.613	.302	16,18	7-24	3.707	Sample 1
7.	Frostig - Figure-Ground Disc.	150	16.400	.231	19	6-20	2.837	Sample 1
8.	Frostig - Form Constancy	150	10.526	.308	12	0-17	3.775	Sample 1
9.	Frostig - Position in Space	150	7.560	.053	8	5-8	.650	Sample 1
10.	Frostig Spatial Relations	150	6.766	.058	7	4-8	.718	Sample 1
11.	Progressive Matrices	150	26.726	.810	36	8-51	9.927	Sample 1
12.	P.M.A. - Total	150	129.993	1.613	133	73-175	19.763	Sample 1
13.	P.M.A. - Verbal Meaning	150	46.600	.466	45	26-58	5.713	Sample 1
14.	P.M.A. - Spatial Relations	150	17. 280	.357	15,16	7-26	4.379	Sample 1
15.	P.M.A. Number Facility	150	37.980	.859	35	13-59	10.530	Sample 1
16.	P.M.A. - Perceptual Speed	150	28.200	.520	28	9-45	6.371	Sample 1
~~17.~~	~~Lorge-Thorndike -Total I.Q.~~	~~406~~	~~104.4~~	~~N/A~~	~~104~~	~~59-143~~	~~N/A~~	~~Entire Population~~

APPENDIX III

CHI-SQUARE COMPUTATIONS

C.T.P. - A, Extreme Scores on M.P.D.
Mean = 29.7

1 σ Above Mean	6 (8.5)	11 (8.5)	17
M.P.D.			
1 σ Below Mean	12 (9.5)	7 (9.5)	19
Total	18	18	36

Chi-Square = 2.78
Significant at .10 level

C.T.P. - B, Extreme Scores on M.P.D.
Mean = 34.5

1 σ Above Mean	8 (8.97)	9 (8.03)	17
M.P.D.			
1 σ Below Mean	11 (10.03)	8 (8.97)	19
Total	19	17	36

Chi-Square = .446
Not Significant

C.T.P. - TOTAL, Extreme Scores on M.P.D.
Mean = 64.4

M.P.D.				
1 σ Above Mean	6 (8.5)	11 (8.5)	17	Chi-Square = 2.80 Significant at .10 level
1 σ Below Mean	12 (9.5)	7 (9.5)	19	
Total	18	18	36	

Highest 34 Scores and Lowest 34 Scores on M.P.D.

C.T.P. - Total

M.P.D.				
1 σ Above Mean	15 (18.5)	19 (15.5)	34	Chi-Square = 2.904 Significant at .10 level
1 σ Below Mean	22 (18.5)	12 (15.5)	34	
Total	37	31	68	

C.T.P. - A

M.P.D.				
1 σ Above Mean	18 (19)	16 (15)	34	Chi-Square = .240 Insignificant
1 σ Below Mean	20 (19)	14 (15)	34	
Total	38	30	68	

C.T.P. - B

1 σ Above Mean	19 (20)	15 (14)	34
M.P.D.			
1 Below Mean	21 (20)	13 (14)	34
Total	40	28	68

Chi-Square = .242
Insignificant

ITBS - Reading

1 σ Above Mean	12 (9.2)	6 (8.8)	18
M.P.D.			
1 σ Below Mean	7 (9.8)	12 (9.2)	19
Total	19	18	37

Chi-Square = 3.394
Significant at .10 level

ITBS - Work Study Skills Total

1 σ Above Mean	9 (7.8)	9 (10.2)	18
M.P.D.			
1 σ Below Mean	7 (8.2)	12 (10.8)	19
Total	16	21	37

Chi-Square = .633
Significant at .50 level

ITBS - READING

1 σ Above Mean	50 (45.5)	27 (31.5)	77
M.P.D.			
1 σ Below Mean	35 (39.5)	32 (27.5)	67
Total	85	59	144

Chi-Square = 2.337
Significant at .20 level

ITBS - W-T

1 σ Above Mean	47 (42.3)	25 (29.7)	72
M.P.D.			
1 σ Below Mean	37 (41.7)	34 (29.3)	71
Total	84	59	143

Chi-Square = 2.547
Significant at .20 level

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APPROVAL SHEET

The dissertation submitted by John R. Noak has been read and approved by members of the Department of Education.

The final copies have been examined by the director of the dissertation and the signature which appears below verifies the fact that any necessary changes have been incorporated and that the dissertation is now given final approval with reference to content and form.

The dissertation is therefore accepted in partial fulfillment of the requirements for the degree of Doctor of Education.

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Date

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